Flight 17 August 1961

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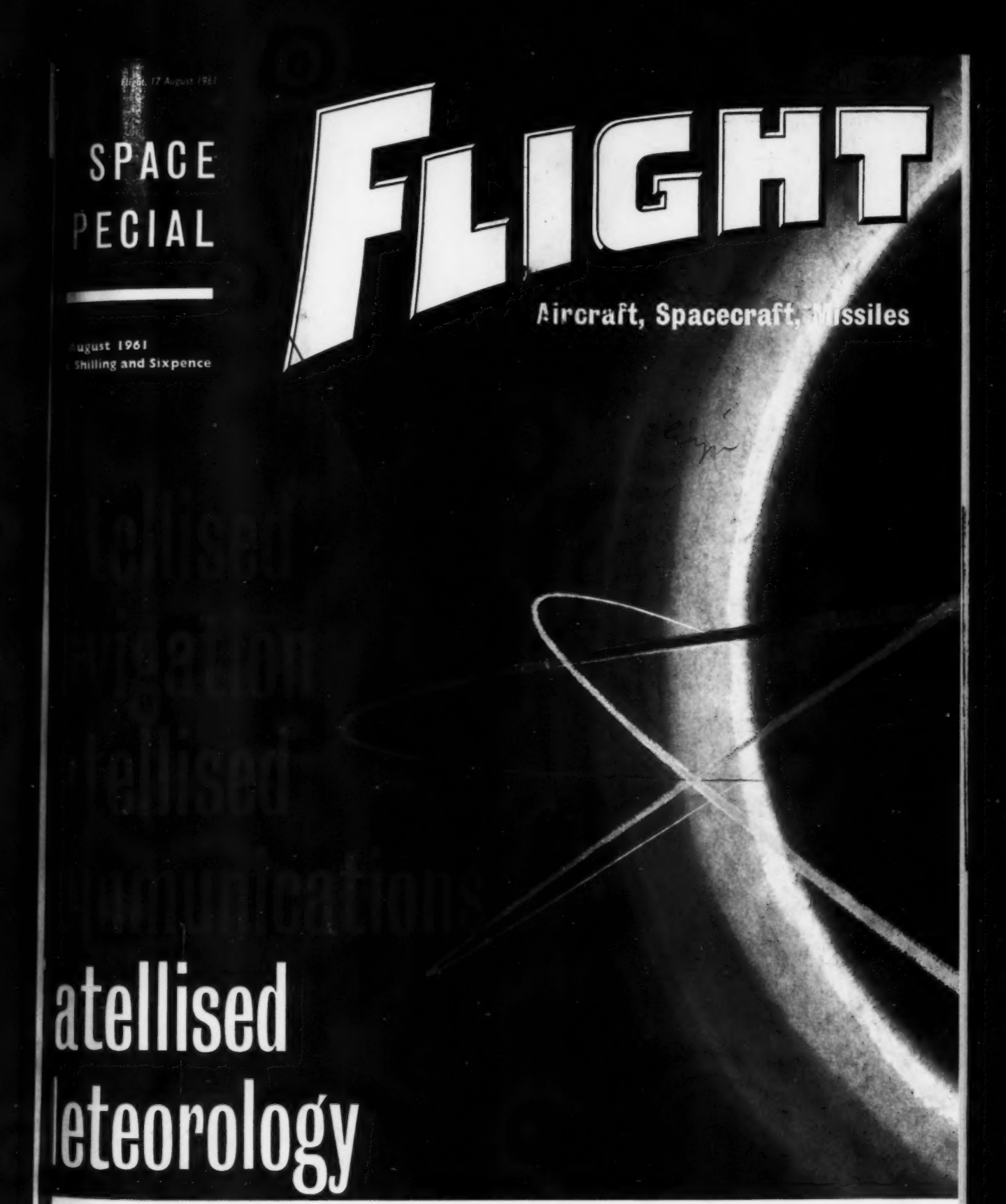

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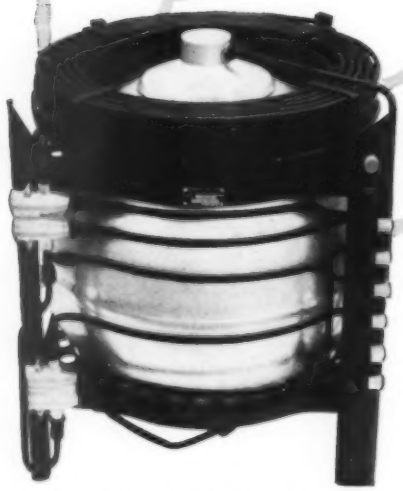

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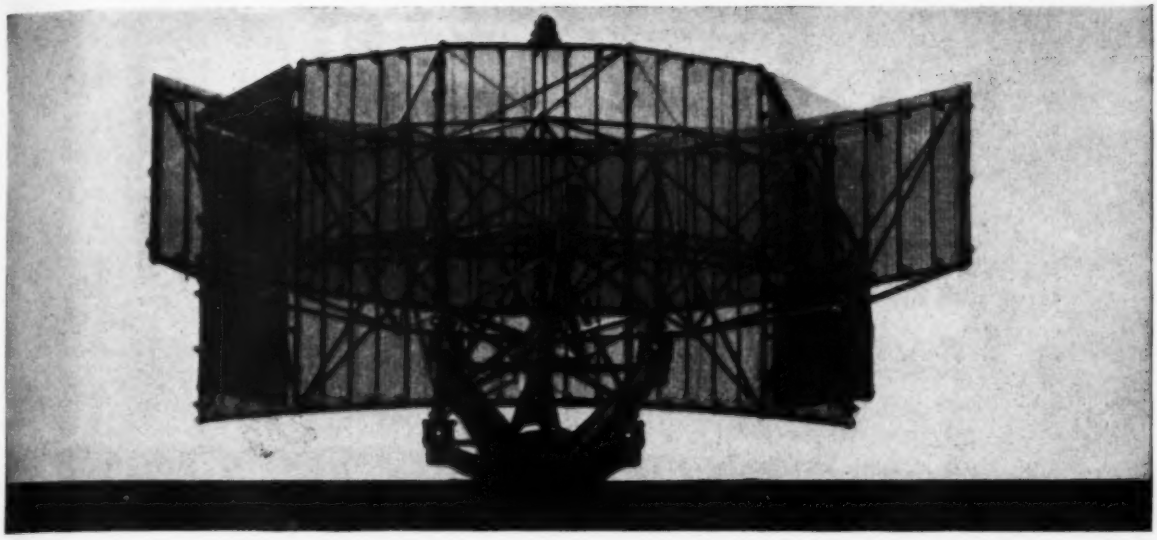

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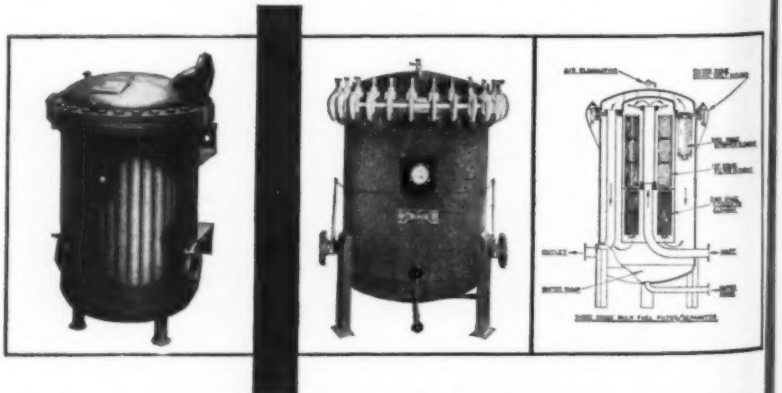

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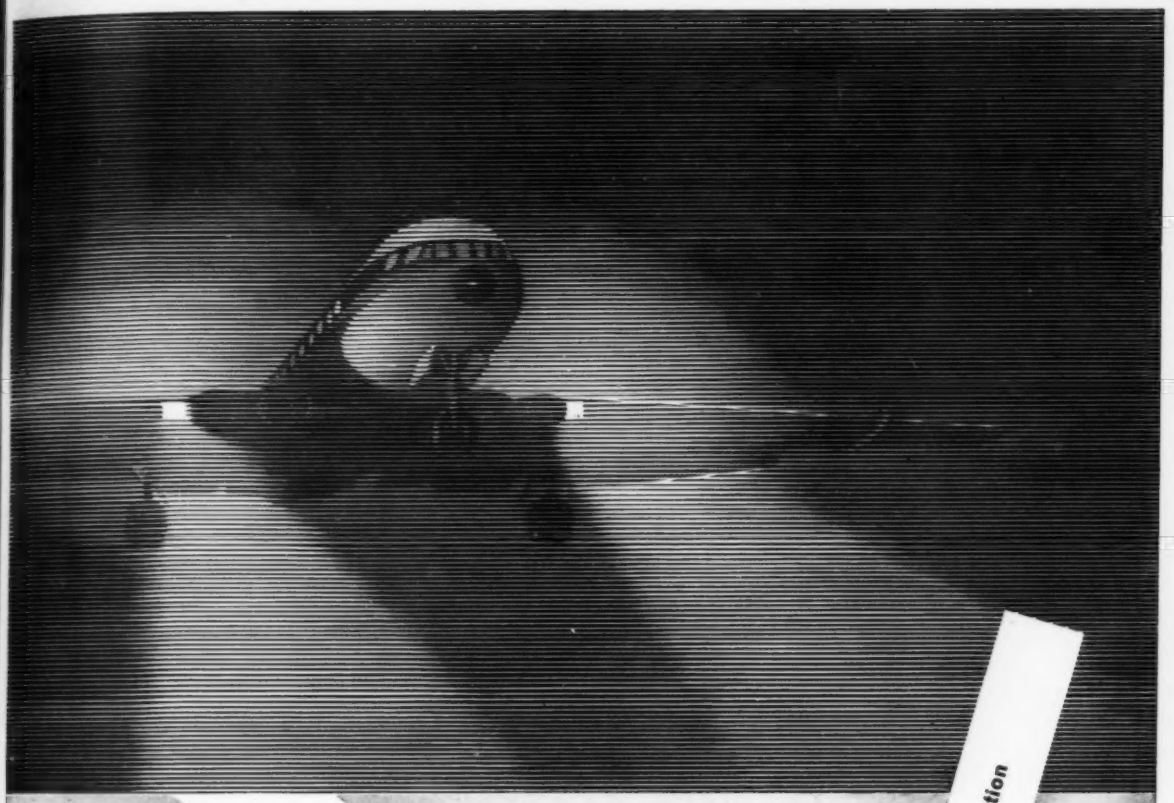

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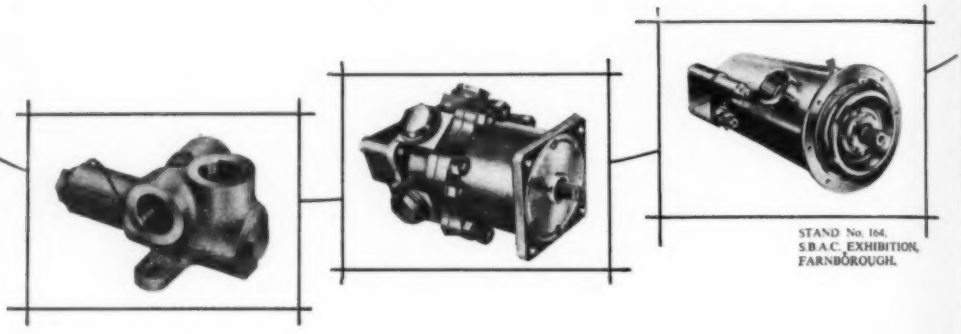

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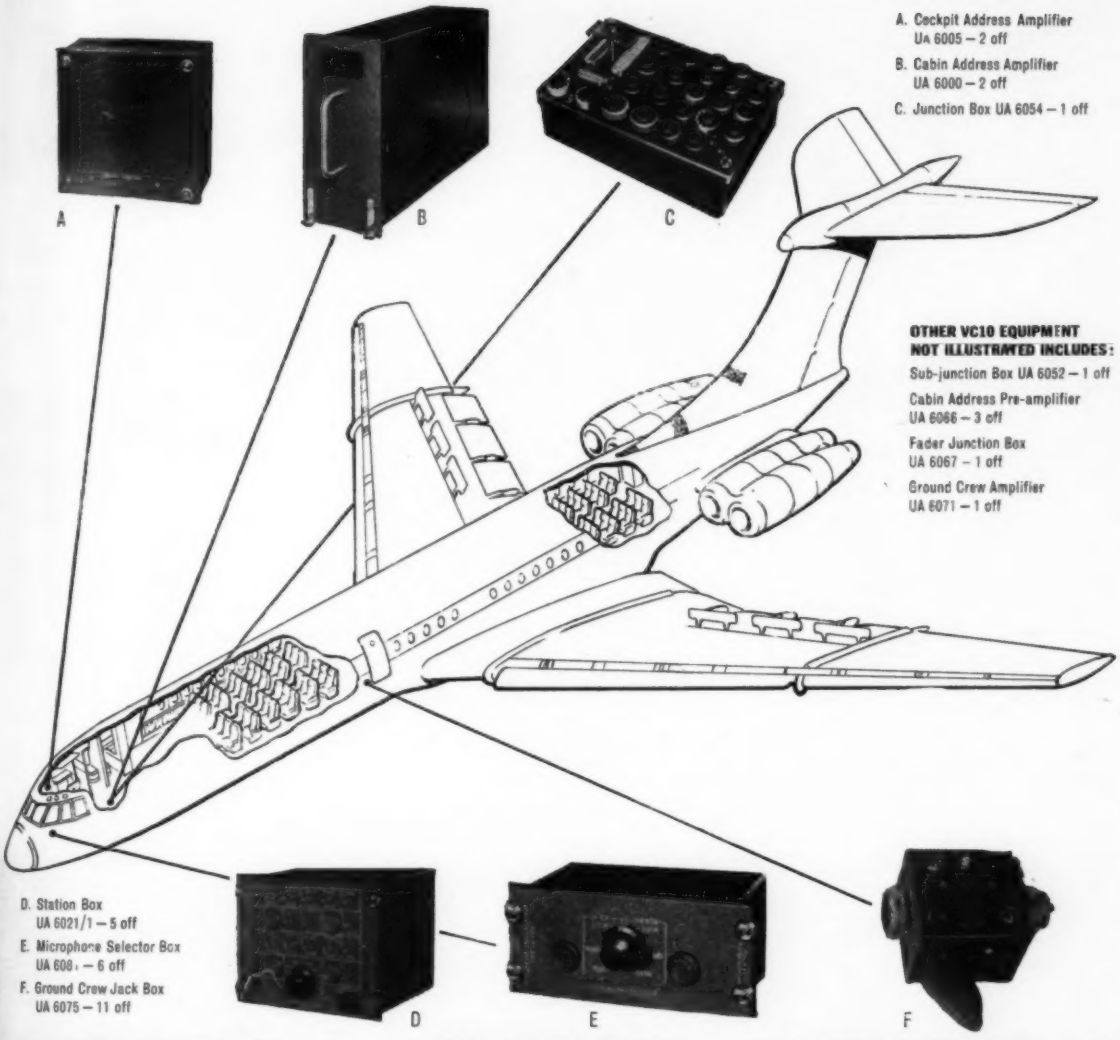

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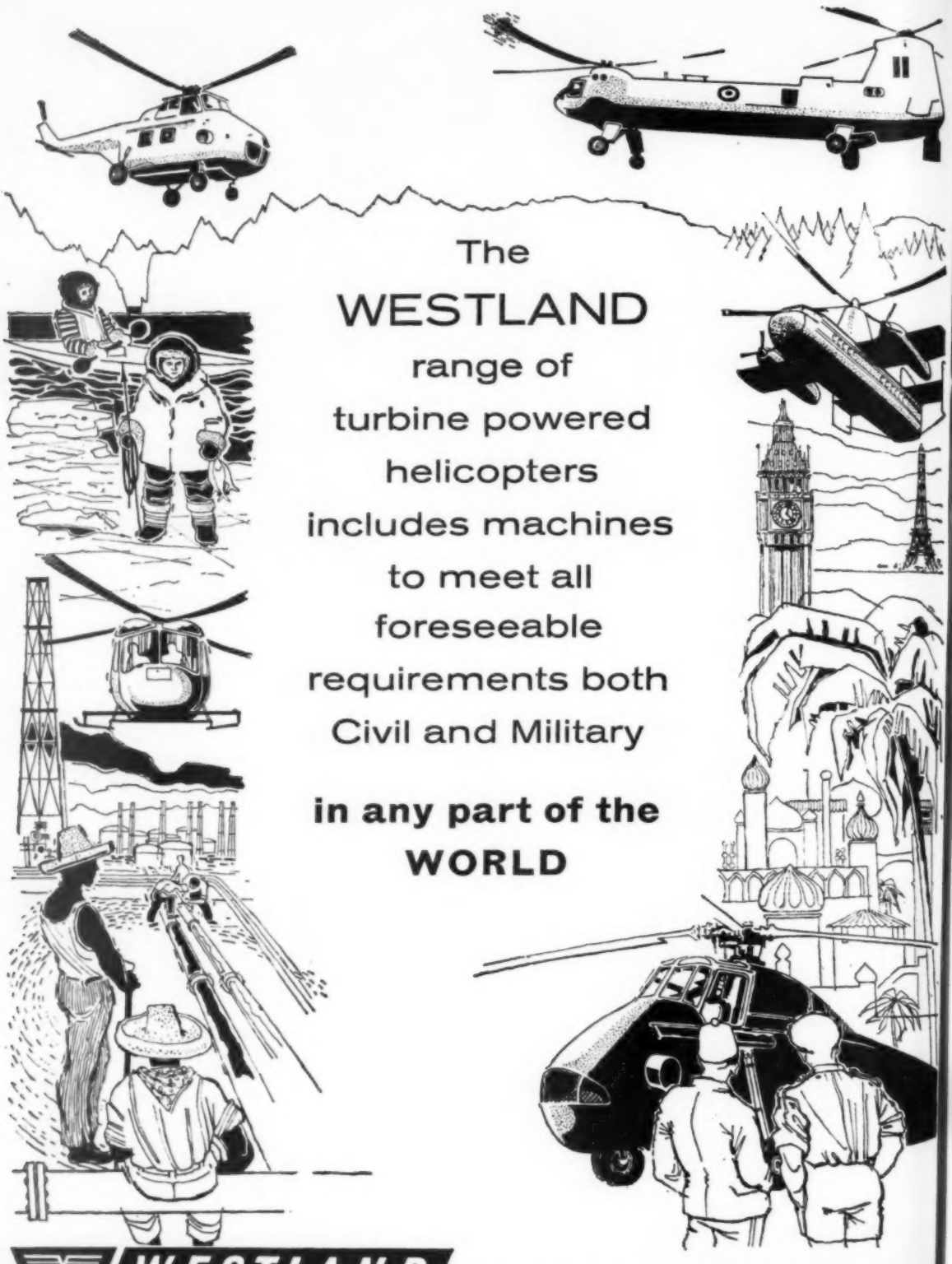

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No 2736 VOLUME 80 THURSDAY 17 AUGUST 1961

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AIRCRAFT, SPACECRAFT, MISSILES

Official Organ of the Royal Aero Club First Aeronautical Weekly in the World Founded in 1909

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Adventure in Space

THE great adventure of man in space, and the challenging prospect of Europe in space, are the main spaceflight themes of 1961—themes which are taken up in this special issue of *Flight*. Since our last such issue twelve months ago we have recorded many significant milestones along the road of space exploration—incidentally notching up world scoops in connection with the Minitrack station at Winkfield, the first joint American/British satellite and the Strasbourg proposals for a European programme. In respect of these milestones, the scientific ingenuity and integrity of the USA is appreciated by those who know; but the ability of the Soviet Union to place man in orbit is acclaimed by the world. Humanity recognizes a new dimension, and 1961 is the year of the astronauts.

Gagarin, Shepard, Grissom and Titov are the pioneers of the new era, and for those with eyes for the future of mankind the journeys of their successors will be the substance of this journal's most exciting and most significant reading. A healthy trend is the increasing flow of information on Soviet space achievements, and *Flight*—the only British aviation journal with a representative at Cape Canaveral to cover Cdr Shepard's flight on May 5—hopes, before too long, to report first-hand from Baykonur. Indeed, the President of the Soviet Academy of Sciences has indicated that this is now a distinct possibility.

On the European scene, there are signs of an imminent announcement of the intergovernmental conference, which may be at Geneva or Strasbourg, to discuss the formation of a joint launch-vehicle organization. Already there is agreement in principle between Britain, France and West Germany to go ahead with the development of a three-stage satellite launch vehicle, and there is no reason for delay in getting down to details with the other countries which might be involved.

A matter of basic principle, rather than detail, is that Europe as a unit should look outwards to co-operation with other countries rather than endeavour to live in an airtight compartment, with the inevitable duplication which this implies. Highly relevant is a recent statement in London by the Director of International Programs of the US National Aeronautics and Space Administration, Dr Arnold Frutkin. Multi-national groupings such as that proposed for Europe, Dr Frutkin said, would multiply the prospects for broad international co-operation in space research: "The United States has welcomed these developments and made clear its willingness to enter into joint projects with the new organizations."

New Role for Farnborough?

Britain's own participation in the proposed European programme, it is suggested in this issue, may be hindered under the present framework by the national multiplicity of departments, establishments, committees and other groups involved in space affairs. The suggestion is put forward that a national space agency or space centre should be established to act as a single authority in negotiations with the European organization.

The Royal Aircraft Establishment, Farnborough, is proposed as a suitable location for such an authority, and indeed the evolution of RAE into a Royal Aerospace Establishment would be a logical and widely welcomed development. But, whatever its location, a single centre is essential. To ignore this, and to attempt to muddle through in a traditional way, would be utter folly.

LOOKING FOR TROUBLE is the function of the nose of the Short SC.9, a converted Short-built Canberra PR.9 for testing the guidance system of the de Havilland Red Top air-to-air missile. The portion illustrated includes the complete Red Top homing head and guidance components. The aircraft will "gather IR data for all kinds of targets and environments, and evaluate target-detection systems"

FROM ALL QUARTERS

H.P.115 First Flight

FIRST flight of the Handley Page H.P.115 was due to take place last Tuesday, August 15, at RAE Bedford. The pilot was to be Sqn Ldr J. Henderson, of the RAE. Handley Page have built the H.P.115 under MoA contract to provide information on the behaviour of aircraft of slender-delta shape at low speeds. Constructed of wood, it has a span of 20ft, length of 45ft and a 2,000lb thrust Bristol Siddeley Viper turbojet, which suffices for speeds of up to about 300 m.p.h. Handley Page believe the aircraft to be "the world's slenderest delta," and its distinctive shape may be seen at the SBAC display next month.

Whitworth Gloster Aircraft

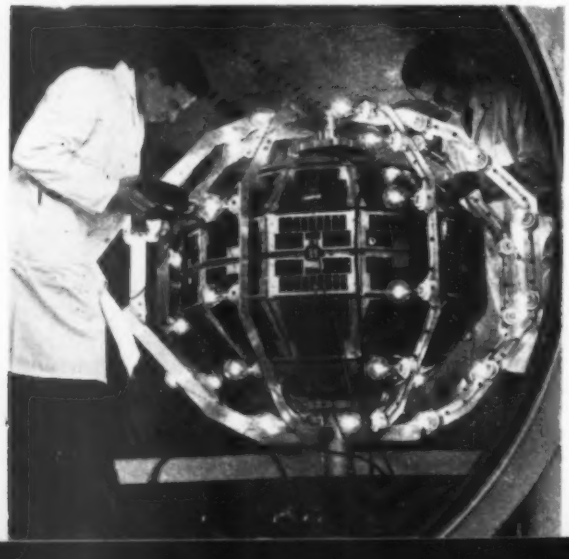
AMALGAMATION of Sir W. G. Armstrong Whitworth Aircraft and Gloster Aircraft into one company immediately—under the name Whitworth Gloster Aircraft Ltd—has been announced by Hawker Siddeley Aviation. This decision has been taken in accordance with the company's policy of "streamlining and strengthening its organization."

Mr Hugh Burroughes, chairman of Gloster Aircraft, is to be chairman of the new company; Mr W. S. D. Lockheed, AWA managing director, will be managing director. Further board appointments will be announced in due course.

Tom Gammon Retires

SINCE 1955 deputy managing director of Vickers-Armstrongs (Aircraft) Ltd, Mr Thomas Gammon, OBE, MIMECHE, is retiring on August 31 after over half a century of unbroken service in the engineering industry. He has been associated with the Vickers Group all his working life, having served his apprenticeship (completed in 1912) with the original firm of Vickers Sons and Maxim at Erith.

He went to Weybridge in 1938; and from early 1940, as works manager there, he was responsible for administration and production in the period when over 11,000 Wellingtons were built at the plant and in "shadow" factories under its guidance. For his wartime services Mr Gammon was appointed OBE in 1943. He became general manager of the Weybridge works in 1953, when the Viscount and Valiant were being developed and produced. He is a council member of the SBAC and of the Aircraft Research Association.



Jet Provosts for Kuwait

THE Kuwait Government has placed a contract with Hunting Aircraft, worth over £500,000, for an unspecified number of Jet Provosts plus spares and initial technical assistance. The machines are to form the nucleus of a Kuwait Air Force.

High-flying Italian

POWERED by a Bristol Siddeley Viper Mk 22 engine of 2,500lb thrust, a Macchi MB326 trainer on August 4 set up (subject to FAI confirmation) a new world altitude record for its class—C/1-D Group 1—by reaching a height of 50,024ft. It was flown by Cmdt G. Carestiato, Macchi chief test pilot, from the company's airfield at Venegono near Varese. The MB326 is the Italian Air Force standard basic trainer, designed to combine viceless characteristics for *ab initio* pupils with the high performance needed for more advanced work.

RESIGNATION of Air Marshal Sir Colin W. Weedon, KBE, CB, MA(Cantab), MIMechE, AFRAeS, RAF (Ret), from his present executive duties as director and general manager, commercial sales, of the Rolls-Royce aero-engine division has been accepted by the company "with regret." Sir Colin, who joined Rolls-Royce in 1952, is to continue with the firm as a senior aero-engine division representative, located at the London offices in Conduit Street

Communications Merger

PLANS for a merger between the Plessey Co, Automatic Telephone & Electric Co and Ericsson Telephones were announced last week. It was stated that the amalgamation would "avoid considerable overlapping of effort in the communications field and lead to a more intensive and efficient use of research and productive facilities." Both Plessey, which has a controlling interest in the new consortium, and Automatic Telephone & Electric are involved in the aviation industry. Among Plessey products are ceramic and transducer materials, complete aircraft electrical systems, communications and de-icing equipment.

Collectors' Items

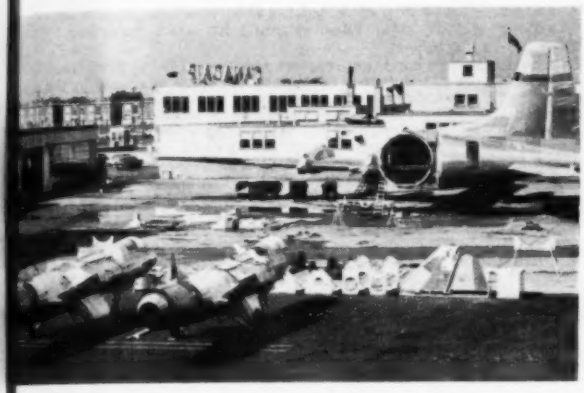
SOME indication of the value of early issues and volumes of *Flight* (not infrequently the subject of enquiries by readers) was afforded by a recent sale by Hodgson & Co, the famous firm of auctioneers, at their salerooms in London.

The most important run of *Flight* was catalogued as: "*Flight*: a Journal of Aerial Locomotion and Transport, illustrations, vols 1 to 6, 11 to 16, 18 to 36, and 3 parcels of numbers ranging between 1941 and 1954, in 34 vols, with Titles and Indexes, cloth, not uniform, 3 unbound, (vol 18 lacks Jan-June, vols 14 and 15 lack Titles, and vol 16 lacks Nov-Dec, Title and Index)." This lot realized £105. Sixteen volumes, between vol 1 No. 12 and vol 32—some in duplicate, some parts missing, and all very imperfect—brought £12.

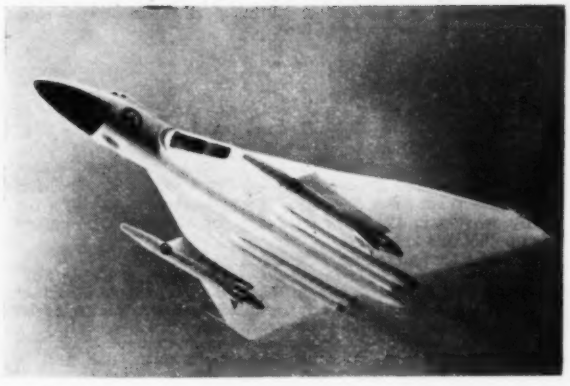
Among the very rare aeronautical items that came under the

TOPSIDE SOUNDER: Canada's first satellite, to be launched by arrangement with the US National Aeronautics and Space Administration by Thor-Agena early next year, will investigate the ionosphere. Here Canadian scientists test the satellite's solar cells

SCHOOL TREAT: There is a light-hearted air about this mixed formation of helicopters. They are Sycamores, Skeeters, Whirlwinds and Dragonflies of the RAF Central Flying School Helicopter Wing and were on their way from Gloucestershire to Shropshire when the unit moved last week from South Cerney to Ternhill



F-104 x 2 INTO CL-44 will go: the proposition was proved recently at a Montreal demonstration, when two F-104G fuselages, plus their engines, wings and tail units, were loaded into a Canadair CL-44 through its swing tail, using a Canadair-developed elevator. The demonstration was to show the feasibility of carrying complete aircraft across the Atlantic for NATO nations



MODEL DETERRENT is represented by this miniature Vulcan (not representative of the latest B.2 version) equipped with two GAM-87 Skybolt missiles. As described in a recent issue, AEI are producing conversion equipment to link the computer systems of the bomber and missile. This is the first official indication that the Vulcan will carry two Skybolts in the positions shown on the model

hammer was: "Stringfellow (F. J.). A Few Remarks on what has been done with Screw-Propelled Aero-Plane Machines, from 1809 to 1892, 6 photo illustrations, Presentation Copy, 7 leaves, as issued (2 corners slightly defective)." This lot realized £30. A copy of the comparatively common *Astra Castra: Experiments and Adventures in the Atmosphere*, 1865, by H. Turnor fetched £9 10s. *Progress in Flying Machines*, by Octave Chanute, published in New York in 1899, realized £10.

A number of ballooning prints and engravings were also auctioned, together with "An extensive collection of photographs, postcards, etc, including commemorative postcards of the Wright Brothers, Bleriot and others, with many relating to World War I." This last collection fetched £84.

First of Many

AUGUST 10 was the date of the first flight of a European-built Lockheed F-104G. The aircraft was the first of 210 to be constructed by ARGE Sud, the South German group, with final assembly at the new Messerschmitt plant at Manching, Bavaria. Current production utilizes US airframe parts and systems, but all-European machines are due before the end of the year. Very shortly the first of "about 400" F-104Gs from the Northern Group will fly from Schiphol.

"Sixty Series" for the Trident

ALL of BEA's 24 DH Tridents will, Marconi announce, be equipped with "Sixty Series" radio and navigation aids of the type specified also by BOAC for their VC10s. The equipment to be incorporated in the Tridents will include: (1) Dual installations of the AD.160 VHF communication equipment (transmitter and receiver) with an additional receiver for each dual installation; (2) dual installations of the AD.260 VHF navigation and approach guidance equipment (receiver + navigation unit + glide-slope receiver + marker receiver). Special measures have been taken to ensure the maximum accuracy and stability of the AD.260 ILS equipment, as this will be used with the Autoland system; (3) dual installations of the AD.360 automatic direction-finder or radio compass (ADF receiver + controller + fixed loop); and (4) "Selcal" type 2880 Aircraft selective calling system.

IN BRIEF

Lord Brabazon of Tara has accepted an invitation from Mr Thorneycroft, Minister of Aviation, to become chairman of the Air Safety Board. He succeeds Air Marshal Sir Charles Guest, who has retired from his appointment as Chief Aeronautical Adviser to the Minister.

The international light-aircraft exhibition, due to be held at Luton Airport from August 29 to September 2, has been postponed until 1962.

It is reported from Canberra that the Australian order for Dassault Mirage IIIs for the RAAF may be increased from 30 aircraft to 100. This follows a recent visit to Paris by the Minister for Air, Mr Athol Townley, who personally evaluated the aircraft.

Sir Bernard Lovell, director of Manchester University's Nuffield Radio Astronomy Laboratories, is to be the first recipient of the Daniel and Florence Guggenheim International Astronautics Award, sponsored by the International Academy of Astronautics.

A Republic F-105 Thunderchief recently attacked a target with more than seven tons of conventional bombs in "a demonstration of limited-war punch." Its load—claimed to be the largest ever carried by a single-engined fighter—consisted of twenty-six 565lb bombs mounted on wing and belly racks. The aircraft was powered by its standard Pratt & Whitney J75 with afterburner.

HIGH-FLYING ITALIAN Commandante G. Carestiato, Macchi chief test pilot, after his 50,024ft flight on August 4 (see p 206). Shaking hands with him is Bristol Siddeley performance engineer Peter Cruickshank; at right is the company's service representative, Mr J. G. Wood

Missiles and Spaceflight

IN THIS ISSUE

A SEVEN-PAGE DESCRIPTION of the three-stage European space launch vehicle, with cutaway drawing, is included in the "Space Special" section of this issue which begins on page 213. Also included are feature articles on European and British space activity, man in space, Soviet rockets, and the American scene, together with tables of spacecraft launched during the last twelve months.

THE FIRST DAY IN ORBIT

A spectacular Soviet achievement was once again combined with an effective sense of timing in the 25hr 18min, 17-orbit flight of Maj Herman Titov in the spacecraft *Vostok 2* on August 6-7. After spending his time in orbit, eating, sleeping, exercising, transmitting scientific and goodwill messages by radio, and observing the Earth through three portholes, the major landed safely in the Saratov area some 450 miles south-east of Moscow, with apparently no ill-effects to report.

The initial Tass announcement stated:

On August 6, 1961 at 09.00 (Moscow time) a new launching into orbit of an Earth satellite—the Spaceship *Vostok 2*—was made in the Soviet Union. The Spaceship *Vostok 2* is piloted by citizen of the Soviet Union, Pilot Cosmonaut Major Herman Stepanovich Titov.

The aims of the flight are research into the effects upon the human organism of a prolonged orbital flight and the consequent landing on the Earth's surface, and to study man's working capacity during a sustained state of weightlessness.

According to preliminary data, the spaceship has been put into an orbit close to the calculated one, with the following parameters: minimum distance from the surface of the Earth (at perigee) is 178km; maximum distance (at apogee) is 257km; the inclination of the orbit to the Equator is 64° 56min. The initial period of revolution of the spaceship is 88.6min. The spaceship weighs 4,731kg, excluding the weight of the final stage of the carrier rocket.

Two-way radio communication is being maintained with Cosmonaut Titov. The cosmonaut is transmitting on frequencies of 15.765Mc/s, 20.006Mc/s and 143.625Mc/s. A signal transmitter operating on frequency of 19.995Mc/s is also on board the spaceship. The equipment on board to sustain the Cosmonaut's vital activity is functioning normally. The Cosmonaut Herman Titov feels well. The flight of the Soviet spaceship, which is controlled by man, is proceeding successfully.

Early progress reports indicated that all was going well. The pilot and his operation of the instruments was being observed by television, and Maj Titov transmitted greetings to the people of Africa while passing over that continent. During the third orbit he sent greetings to the peoples of the Soviet Union and Europe, after which he had a three-course lunch (consumed in paste form from tubes). At the beginning of the fourth orbit he had an hour's rest, in accordance with the flight programme, and "after this the cosmonaut did physical exercises and did further work as set by the flight task." More greetings towards the end of this circuit, this time to the peoples of South America.

Maj Titov reported the smooth functioning of all the equipment aboard the spacecraft. For an hour he "tested the spaceship's systems of manual control, after which he reported on the good controllability of the craft while manœuvring with the aid of manual control." During the fifth orbit, Tass announced, "During the flight over Soviet territory the radio-television system transmitted pictures showing the calm and smiling face of the Soviet cosmonaut. Through the multi-channel radio-telemetric system extensive information of a scientific nature continued to come in, as well as detailed data about the functioning of the spaceship *Vostok 2*. While flying over Kwangchow Maj Titov sent greetings to the peoples of Asia, and while flying chow over Melbourne he transmitted greetings to the people of Australia."

Greetings were exchanged during the sixth orbit between Maj Yuri Gagarin and Maj Titov. The *Vostok 2* pilot again operated the craft's manual controls, and "the ship reacted well to the pilot's steering." Over Moscow at the beginning of the seventh orbit, Maj Titov bade Muscovites goodnight before settling down for the night. With radio transmissions suspended, he was scheduled to rest and sleep from 6.30 p.m. (Moscow time) to 2 a.m. the next day.

Awaking at 2.37, Maj Titov resumed his work according to schedule. Tass reported:

"The cosmonaut's condition remains excellent. Having breakfasted well at 05.45 the cosmonaut is continuing the work envisaged by the programme of scientific research. The spaceship *Vostok 2* carries much equipment, including radio-technical systems of trajectorial measurements, multi-channel telemetric systems ensuring objective observation of the condition of the cosmonaut and the control of the work of all the devices on board, short-wave and ultra-short-wave receiving and transmitting apparatus, and a tape recorder intended for recording the speech of the cosmonaut and the automatic accelerated reading of recordings upon command from Earth . . .

"The spaceship also carries scientific apparatus for obtaining supplementary data on the influence of cosmic radiation on living organisms. On board also are biological objects. During the flight observation of Earth and sky is carried out through three portholes. The cosmonaut may also, if he wishes, use an optical instrument of 3-5 magnification."

After further announcements, the news of the landing came at 9 a.m. GMT on August 7, when Tass announced:

"The Soviet spaceship *Vostok 2* piloted by cosmonaut Maj Herman Stepanovich Titov has completed over 17 revolutions around the Earth in 25hr 18min and has flown over 700,000km.

"Having successfully fulfilled the scientific research programme, the spaceship *Vostok 2* was brought near the pre-determined area, not far from the historic place where pilot-cosmonaut Yuri Alekseyevich Gagarin landed the spaceship *Vostok 1* on April 12th 1961. Comrade Herman Stepanovich Titov is in good health and is feeling very well.

"The prolonged space flight by a Soviet cosmonaut, unprecedented in the history of mankind, has been successfully completed. The research results obtained are opening up broad prospects for the further development of space flights by man."

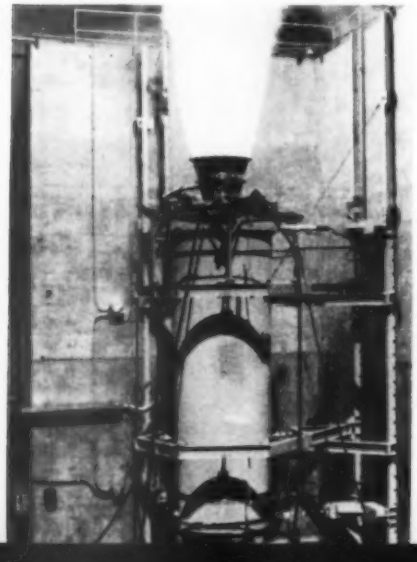
At a press conference in Moscow on August 11, Maj Titov disclosed that, unlike Maj Gagarin, he had ejected himself from the *Vostok 2* cabin at low altitude and had descended to earth by parachute. He said that the automatic landing system came into operation as predetermined at the beginning of the 17th orbit. He had permission to use either of two methods—remaining within the cabin or firing the ejector seat. "After the braking engine had been switched in and the ship had entered its descent trajectory, I felt very fit and decided to try the second landing system." The major continued, "At a low altitude the seat was ejected and my further descent was by parachute. The ship landed successfully nearby."

During the re-entry phase of the flight, Maj Titov commented, "I was very interested to observe the brilliant luminescence of the air around the spaceship as it entered the denser layers of the atmosphere, and the changes in colour of this luminescence as my speed and altitude changed. When the deceleration forces began to act, the weightless condition came to an end, but I observed no sharp or abrupt transition—I felt simply that I had returned to a normal state."

Asked whether *Vostok 2* could have accommodated two men, Maj Titov said that in principle this was possible, but the spaceship had been designed to carry one man. He had kept the helmet of his space suit opened almost all the time; conditions in the cabin had been perfect, and the air had been better than in cities.

Prof Mstislav Keldysh, President of the Soviet Academy of Sciences, was asked at the same conference whether foreign correspondents would be able to witness future launchings of Soviet spaceships. He answered "Yes, they will be, undoubtedly, and we are doing all we can to bring it about." Asked what would be the next stage in Soviet space exploration, he said that Soviet scientists and designers were working under a broad plan which covered orbital flights and flights to the nearest planets. Spaceship design could be further improved for successful interplanetary flights.

Further information on Maj Titov and his flight, including an eye-witness account at the launch site, is contained in the article *The Year of the Astronauts* on pages 216-219.



On August 5 United Technology Corporation achieved a major milestone in firing the first operational prototype of a booster-size segmented solid-propellant rocket motor. The three segments contained nearly 80,000lb of propellant. Thrust achieved was approximately 250,000lb for 80sec, and UTC say "The success of the test means that the major roadblocks in the production of single rockets of up to 3,000,000lb of thrust have been overcome. By clustering such motors, thrusts as high as 25,000,000lb can be produced"

SAFELAND

Standard Runway Barrier for the RAF: Testing and adoption of a Swedish System

THROUGHOUT the history of aeroplane design, landing speeds have increased and the unit price of aircraft has risen. During World War Two combat machines could be written off the books of the major air forces at the rate of hundreds per day; but today the loss of a single first-line aeroplane has measurable repercussions on the national Exchequer. Increasingly, runway overrun barriers make economic sense, in order to restrain brakeless or aborted aircraft from hurtling off the runway and across the countryside.

Runway-overrun problems are particularly acute in Sweden, where the fastest jet fighters have to be operated from modest-sized strips in icy or wet conditions. Eight years ago the Royal Swedish Air Board charged the Air Test Development Centre at Malmslätt with the task of developing a suitable arrester barrier. It is significant that the establishment was told to have a prototype barrier ready in six months.

On an aircraft carrier an arresting system is required for virtually every fixed-wing landing. Only 20ft to 50ft of axial deck-space is available for bringing aeroplanes to rest, and the requirements can be met only by a massive hydraulic installation. On a runway the space available may be 200yd (it all depends where the barrier is placed); but it is highly desirable so to design the barrier that the complete installation becomes an air-portable package, which can be readily uplifted and moved to another runway or another airfield.

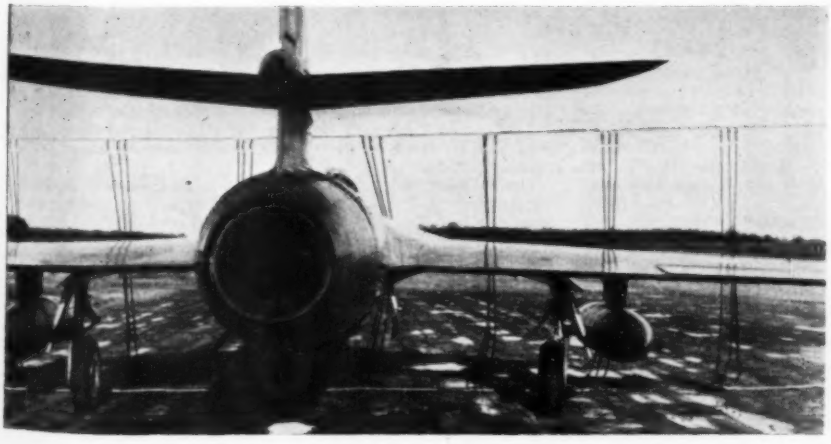
In planning the basic design, Maj P. B. Fonden—the pilot/engineer responsible for the work at Malmslätt—accepted the idea of a net-type barrier, but took pains to ensure that the braking force was imparted to the aircraft at the highest possible point. The obvious part of the airframe able to bear arresting loads at a considerable height from the ground is the wing leading edge. Heavy rearwards forces applied here normally cause no violent change in aircraft attitude, whereas drag loads applied by a cable a foot or so above the ground would almost certainly cause severe damage to the undercarriage.

Basically, Maj Fonden's (Safeland) barrier consists of a winch-type braking mechanism around which is coiled a specially made steel cable which extends across the runway to a winch on the other side, the "ground main cable" lying across the runway being connected by numerous vertical strips of nylon rope to a suspension main cable which hangs in a catenary from a folding mast system on either side. The usual effective width of the net is 180ft.

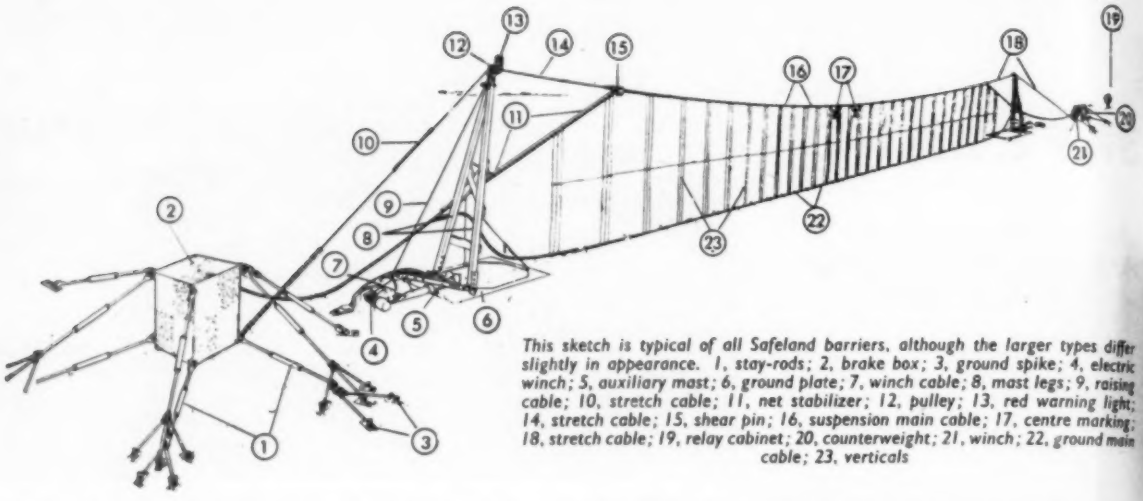
In practice the basic idea of the net is that the whole front end of the aircraft should pass between the verticals, preferably those nearest the centre, and beneath the suspension main cable, resulting in the verticals folding back across the wings. As the aircraft moves forwards it pulls the barrier out into a vee shape (seen from above) carrying the ends of the barrier clear of the masts and pulling the cable drum of the brake round against a variable torque imparted pneumatically through a stack of sintered brake discs inside the drum. Horizontal spacing of the verticals is dictated by the need to engage three sets of verticals on each wing while avoiding engagement with air intakes or any projection ahead of the leading edge. Length of the verticals is varied to stabilize aircraft striking the barrier asymmetrically. Pneumatic pressure to the brake is applied as soon as the drum has revolved half a turn; but the pressure builds up relatively slowly, so that the verticals fold back across the wings and start to pull out the main cables before any heavy drag forces are applied.

Normally the barrier is lowered to lie flat on the ground, small supports being provided at intervals along the main cables to prevent them from freezing to the ground in Arctic conditions. Electric winches, controlled either directly or from the tower, can elevate the barrier in some 6sec (under 3sec from the "ready" position), and keep the barrier properly tensioned at all times.

After exhaustive trials during 1954-55, culminating in live tests with Vampires and a J29, the Royal Swedish Air Board approved Maj Fonden's barrier and awarded manufacturing rights to Borgs Fabriks Aktiebolag, of Norrköping. Very shortly the original



Seen in the two views on this page is a Hunter —one of the four types of aircraft used by RAE Bedford for the trials of the Safeland barrier—after engaging the arrester on an ice-covered runway. It will be noted that the spacing of the nylon ropes allows the nose of the aircraft to project through the barrier, so that the pilot's exit from the cockpit is not obstructed



This sketch is typical of all Safeland barriers, although the larger types differ slightly in appearance. 1, stay-rods; 2, brake box; 3, ground spike; 4, electric winch; 5, auxiliary mast; 6, ground plate; 7, winch cable; 8, mast legs; 9, raising cable; 10, stretch cable; 11, net stabilizer; 12, pulley; 13, red warning light; 14, stretch cable; 15, shear pin; 16, suspension main cable; 17, centre marking; 18, stretch cable; 19, relay cabinet; 20, counterweight; 21, winch; 22, ground main cable; 23, verticals

Type 4 : 3 was placed on the commercial market, and from this has stemmed by far the biggest export sales of any such equipment in the world. Switzerland was the first customer; and the countries where Befab Safeland barriers may now be found are listed separately, together with the types of aircraft which have been successfully engaged. Well over 400 installations are now in use.

In May 1956 Safeland (England) Ltd was formed to promote sales of the Befab barrier in the Commonwealth. The immediate market was RAF Fighter Command, who had stated a requirement for such equipment many years previously, leading to extensive tests in this country of experimental barriers. Initially a 4 : 3 barrier was brought to England, and designated Airfield Emergency Barrier Installation Mk 5 (for there had previously been four experimental British designs). Later, a 6 : 3 was imported, and designated Mk 6.

Between February 10 and August 14, 1958, a series of 25 live tests were conducted with both sizes of barrier at the RAE Bedford. The types of aircraft employed were the first English Electric P.1A prototype, and a Canberra, Hunter and Javelin. All kinds of engagement were tested, the maximum entry speed being 88kt, and barrier brake pressure was varied between 73 and 145lb/sq in. In general, the basic soundness of the design was amply confirmed, but various types of airframe damage were suffered in a number of engagements as a result of difficulties which, with one or two exceptions, could quickly be cured by minor modifications. On the Mk 5 barrier the verticals were brought closer together (4ft 3in instead of 4ft 7in) to ensure proper engagement with the Gnat trainer, and minor changes in materials and detail design were recommended, together with certain limited alterations to the aircraft.

Today, almost every major operational airfield in the RAF is fitted with at least one (usually two) Safeland barrier, and the equipment is found in use at the little-known staging posts on Transport Command global routes.

Types of Barrier Type 2 : 1H, manually operated, total braking effect 3,300lb, suitable for target aircraft (Jindivik and similar types); price £2,345. Type 4 : 3H, total braking effect 17,000lb, suitable for aircraft weighing up to 19,000lb (all first-generation jet fighters); price £4,350. Type 6 : 3HS, equipped with shock absorbers, total braking effect 26,000lb, suitable for aircraft weighing up to 30,000lb (Lightning, Javelin and Canberra at less than gross weight); price £5,940. Type 12 : 3HS, total braking effect 54,000lb from two brakes on each side of the runway, suitable for aircraft weighing from 26,000 to 62,000lb; price £9,068; Type 60 : 2, total braking effect 132,000lb and suitable for aircraft weighing from 44,000 to 155,000lb. Type 120 : 4, total braking effect 264,000lb and suitable for aircraft weighing between 89,000 and 310,000lb. Types 60 : 2 and 120 : 4, and a whole family of intermediate-size barriers of generally the same design, are still under development.

Customers At the time of writing, Befab Safeland barriers have been delivered to Argentina, Australia, Denmark, Finland, France, Germany, Greece, Holland, India, Indonesia, Iran, Italy, Jordan, Norway, Pakistan, Peru, Spain, Sweden, Switzerland, Turkey, United Kingdom (including RAF bases in Germany and many other parts of the world) and the USA (including USAF Europe).

Aircraft Types At the time of writing, Befab have been notified of successful engagements, either in test or emergency, with the following types of aircraft: Australian GAF Jindivik; Blackburn Buccaneer; Dassault Mystère II; Dassault Mystère IV; de Havilland Vampire; de Havilland Venom; de Havilland Sea Vixen; English Electric Canberra; English Electric Lightning; Folland Gnat; Gloster Javelin; Gloster Meteor; Hawker Hunter; Mig-17 (Indonesia); NAA F-86 Sabre; NAA F-100 Super Sabre; Republic F-84G Thunderjet; Republic F-84F Thunderstreak; Saab 29; Saab 32 Lansen; Saab 35 Draken; Sud Vautour; Supermarine Scimitar; Supermarine Swift.

JET NOISE STUDY

REPORTING an investigation into the effects of jet engine noise, the Building Research Board of the DSIR says in its annual report* that their first year's work "has upset all previous theories and results from other investigators, but at present there are no new theories available to replace them." The board's research station at Garston, Herts, have been using a jet engine in an open field to study the path of noise over the ground at distances of up to three-quarters of a mile. To allow for the effect of changing weather, records have been made once a week for a year.

Mr. F. M. Lea, director of the station, says that vibration damage to buildings attributable to low-flying aircraft and jets running-up on the runway has been found to be quite minor, though noise-level was high. Most complaints are related to sonic-bangs, though in some cases damage has been proved to have existed—unnoticed—before they occurred. "It would appear," Mr Lea comments, "that an aircraft flying supersonically above 30,000ft will perhaps cause only one case of very minor damage. At 20,000ft it may produce a number of cases of minor damage. At very low altitudes, of the order of 1,000ft, however, supersonic flight may cause extensive damage."

*"*Buildings Research 1960,*" published for DSIR by HMSO. Price 7s 0d (by post 7s 6d).*

INFORMATION INTERNATIONALLY

IN London next month (September 6-16) the International Federation for Documentation (FID) is holding its 27th conference. This organization is the international counterpart of ASLIB, the Association of Scientific Librarians, which was established in 1924 and operates under the aegis of the Department of Scientific and Industrial Research. Both the federation and the association have as their function the systematic collection of scientific and economic information.

The FID conference, which is being held at Caxton Hall, Westminster, will include papers on scientific and technical information, economic and managerial information, and problems affecting the efficient use of information. There will also be an exhibition.

MORE FLYING SCHOLARSHIPS

IT is planned to make available 100 flying scholarships a year to boys attending schools at which there is no ATC unit or RAF section of the Combined Cadet Force. These scholarships will be in addition to the 350 already awarded to members of the air cadet organizations. This was announced by the Air Minister, Mr Julian Amery, in the House of Commons last week.

ROLLS-ROYCE AVON turbo jets

Rolls-Royce Avon powered Lightning supersonic fighters are in squadron service with the Royal Air Force

Rolls-Royce Avon engines in military and civil operation have flown more than 4½ million hours. The latest military Avons are fully supersonic engines both with and without re-heat. All Avons offer a long overhaul life coupled with low maintenance. They are in quantity production and are powering fighters, bombers and transports in service with the armed forces of seventeen countries.

ROLLS-ROYCE

AERO ENGINES · MOTOR CARS · DIESEL AND PETROL ENGINES · ROCKET MOTORS · NUCLEAR PROPULSION

The Folland Lightweight fully-automatic Ejection Seat, Mark 4, is standard equipment for the Gnat Trainer which is now in quantity production for the Royal Air Force. The parachute equipment is manufactured and has been developed by the G. Q. Parachute Company in conjunction with and to the specification of Folland Aircraft Limited.

G.Q. LEADERS IN PARACHUTE DEVELOPMENT

G. Q. PARACHUTE CO. LTD., Stadium Works, Portugal Road, Woking, Surrey, England

FLIGHT SYSTEM SURVEY

Ringing-up from the Air

NEARLY four years ago the United States Federal Communications Commission granted experimental authorization for ground stations in Chicago and Detroit to be used for public radio-telephone communications with aircraft. This was the culmination of a long period of study and a decision by the Bell System to establish a nation wide, air-ground public radiotelephone system solely for commercial and private aircraft. At that time some 600 aircraft were obtaining public radiotelephone service through the coastal harbour stations in the United States, but these stations gave priority to shipping, so the aircraft service frequently suffered long delays.

Although this first experimental airborne service was limited in its coverage area, the tests showed that within that area the service was superior to that previously available. Accordingly, the Bell System made application for additonal stations in order to increase the service area. On August 15, 1960, additional stations located in Newark, Washington and Pittsburgh were opened. These additional stations, together with those first used experimentally, have given substantially complete coverage at 5,000ft from about 100 miles west of Chicago to about 100 miles east of New York. Service could now be available to about a third of all US private and executive aircraft, and to almost a fourth of all commercial flights, at altitudes of above a mile.

These experimental stations were established on frequencies assigned to domestic ground radio communications on a shared basis. However, on January 25, 1961, the Federal Communications Commission amended its rules and has now allocated six channels exclusively for air-ground service. The channel assignments are:—

Channel Numbers	Ground-to-air	Air-to-ground
	Mc/s	Mc/s
Signalling	454·99	
1	454·95	459·95
2	454·90	459·90
3	454·85	459·85
4	454·80	459·80
5	454·75	459·75
6	454·70	459·70

With these channels available on a nationwide basis, it was possible to lay out a master plan to give service to aircraft flying on established airways within the United States except for Alaska and Hawaii. This has been done by engineers of the American Telephone and Telegraph Co, using as criteria the avoidance of co-channel interference at all altitudes up to about 30,000ft and providing substantially continuous coverage at an altitude of 5,000ft. In the diagram is a highly simplified first approximation of coverage from a ground station with antenna height h_1 to an aircraft flying at an altitude of h_2, assuming a smooth earth and 4/3 earth radius. From this simple diagram it is apparent that (1) to avoid co-channel interference at 30,000ft, the same frequency cannot be used at any two ground stations spaced less than about 500 miles apart; (2) that, to obtain substantially complete coverage at 5,000ft, ground stations must be less than about 200 miles apart.

The so-called three-channel route plan has been derived from these fundamental considerations. In this plan, channels numbered 1, 2 and 3 are used at successive ground stations over any individual route followed, in order, by the same numbered stations as required to cover the length of the route. While Channel 1 is within 200 miles of Channel 2 and, similarly, Channel 2 is within 200 miles of Channel 3, Channel 1 is never less than 500 miles from another Channel 1, nor is Channel 2 within less than 500 miles from the succeeding Channel 2. Of course, where routes intersect or branch out, it becomes necessary to employ more than the three channels to meet these two criteria.

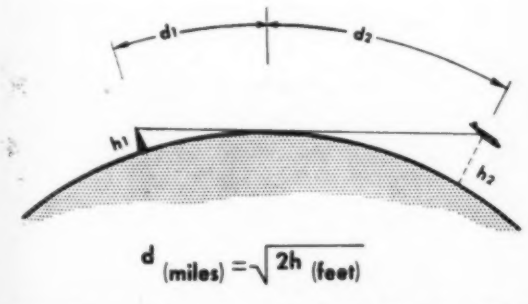
It is expected that six-channel operation will go into operation on January 1 next year, a series of ground stations along the major airline traffic routes from coast-to-coast across the continent being placed in service. Another series of ground stations will be built in the south-eastern and north-eastern United States to supplement the present five-city system. In following years, both Bell and Independent Telephone Companies will extend the service into other areas to provide substantially complete coverage of the continental United States. Canadian interest in air-ground public telephone service has already been evidenced and it is probable that Canadian air-ground installations will follow the same pattern.

As in shipping, the airborne radiotelephone will be customer-owned. AC Spark Plug, the Electronics Division of General Motors Corporation in Milwaukee, Wisconsin, have developed the Skyphone, which has been designed specifically for this public air-ground radiotelephone service. The photograph below shows this new equipment (less control head and handset). The control unit with its hang-up headset may be located at any convenient point in the aircraft. The antenna will be mounted on the lower side of the fuselage, and the ½ATR, 22lb transmitter-receiver unit with self-contained power supply and selective signalling decoding equipment can be mounted with other radio equipment in the aircraft.

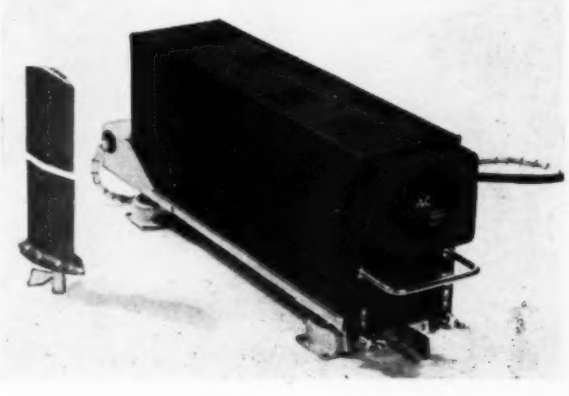
To originate a call from an aircraft the calling party, after lifting the handset from its cradle, selects the appropriate channel for the coverage area. This is done by depressing a selector bar on the face of the control unit until the desired number appears. After listening to make sure that the frequency is idle, he depresses the push-to-talk button on the handset momentarily and then listens for response from the aviation operator in the telephone central office. After receiving her query, he furnishes her with the necessary information to enable her to complete the landline telephone connection. Private and business aircraft may have calls charged to their Sky-phone telephone number, while airline passengers will use credit cards or reversed-charge calls.

Passengers in the radiotelephone equipped aircraft are likewise available by telephone to people in their homes, offices, telephone booths, radio-telephone-equipped vehicles or other aircraft. Anyone wishing to call an aircraft passenger must first have information about the aircraft's approximate location when the call is placed. He dials the long-distance operator, to whom he gives the necessary information. The aviation operator at her position in the telephone central offices then dials the individual aircraft over the signalling channel.

Every ground station for aviation service has the signalling channel available, and all airborne radio-telephone equipments for the public airborne telephone service automatically revert to the signalling channel at the end of each conversation. The signal is received by all aircraft within range of the ground station; but the bell indicating an incoming call rings only in the aircraft being called. Incidentally, the dialling operation also transfers the airborne radio equipment to the proper "talking" channel. The called party in the aircraft merely lifts the handset from its cradle and responds to the call. From that point on, the conversation progresses in the same manner as with an airborne-originated call.



Coverage from ground station. Ranges: 5,000ft, 100 miles; 10,000ft, 140 miles; 20,000 ft, 200 miles; 30,000ft, 245 miles. Right, airborne R/T equipment, with aerial but less control unit and handset



At the Tiger Club Air Show at Fair Oaks Aerodrome on Monday, August 7, the programme included this tied-together Tiger Moth formation, seen flying over one of Fair Oaks Aero Club's joyriding Austers. The Bank Holiday weather was superb for the display, which attracted large crowds

Sport and Business

HAMPSHIRE COUNTY COUNCIL objections may prevent the recently formed Blackbushe Aero Club from operating from Blackbushe Airport. It was reported on August 10 that the council's planning committee had rejected an application for light aircraft to use the site in question, which comprises a large portion of the original airport area and is now owned by AVM Donald Bennett. The club had applied for permission also to a number of local councils and to the Ministry of Aviation.

An enthusiastic response to the idea of forming Blackbushe Aero Club was evident at the inaugural meeting recently, and approximately 100 members have been enrolled. The club is now going ahead with plans to obtain aircraft and to provide both flying instruction and facilities for qualified pilots, and is applying for ABAC membership. The committee of the club comprises D. Walker (chairman), Mr and Mrs K. Gray (secretary/treasurer and assistant secretary), S. Attwood, R. E. Coates, S. G. Cornford, R. C. Hayes, G. H. Hilder, E. Laslett, W. D. Milford, R. G. Procter, R. J. D. Rimmer, J. W. Rose, G. Slavin and C. R. Watson.

CLUB FLYING RATES were discussed at a meeting of a number of flying clubs and schools at the offices of the Association of British Aero Clubs on July 26. The object of the meeting was to discuss the economics of club and school operations and to consider whether the flying rates now being charged were sufficient to cover "the ever-increasing overheads." On the latter question the unanimous conclusion was that the rates were not sufficient.

Other topics raised at the meeting included the training of instructors, the standards of training and testing at certain clubs, and the fuel tax rebate. Organizations represented were Denham Flying Club, Exeter Aero Club, London School of Flying, Midland School of Flying, Oxford Aviation, Plymouth Aero Club, Southend Municipal Flying School, and Surrey and Kent Flying Club.

CANDIDATES for positions as assistant flying instructors with the Air Schools Group's London School of Flying and Midland School of Flying at Elstree and Derby (and as second officers with Derby Airways at Derby and Cardiff) are to be trained by the Elstree organization. The first batch of applicants has been selected and will start full-time training on August 29, and the second class will begin its course on October 24. The closing date for applications is September 8. Candidates who pass the initial selection procedure and show satisfactory progress will be given financial assistance towards the cost of training, up to £350 or 25 per cent of the cost, on an interest-free, repayment-from-salary basis.

Present Air Schools plans include an expansion of the Midland School at Derby, eventually to embrace commercial pilots' courses as at Elstree. The aircraft fleet is adjusted between the two schools according to demand; at present five Chipmunks and three Austers are operated at Elstree, with two Chipmunks and one Auster at Derby. An eighth Chipmunk will be introduced into service shortly.

WINNER of the Northern Gliding Contest organized by Derbyshire and Lancashire Gliding Club from July 30 to August 7 at Camphill, Great Hucklow, was H. R. Dimock of the Royal Navy Gliding Club, flying a Skylark 3F. Runners-up to Mr Dimock, whose points total was 446, were S. Morrison and P. Hanneman (Skylark 3F) with 443pts; and M. Bird of London Gliding Club, also flying a Skylark 3F, was third with 247pts.

FORTHCOMING EVENTS at the Kronfeld Club, London, include the annual dinner and dance on Friday, October 6, at the Eccleston Hotel; and the fourth annual painting and drawing exhibition and competition during November 15-25 at the club.

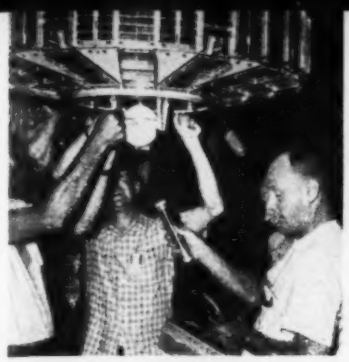
THE PROTOTYPE of a new standard-class sailplane, built at the Jämi Gliding School, Finland, is now flying. Designated the PIK-16 Vasama (Arrow), the new aircraft made a promising start by setting up a new national 300km triangle speed record, 86.6km/hr, with Jorma Jalkanen as pilot, before its initial flight tests had been completed. The design intention was to obtain an L/D ratio of about 34 in an aircraft strong enough to permit fast flying in rough conditions, together with the ability to use weak thermals and small landing areas. The solution was found in high aerodynamic smoothness, the use of a thin wing, and relatively low wing loading.

Designed by Tuemo Tervo, Jorma Jalkanen and Kurt Hedström, the PIK-16 has a 15m span, 19.2 aspect ratio, and a calculated L/D of 34.5 at 86km/hr. A 90° vee-tail is incorporated. Work on a second prototype is expected to begin in the autumn.

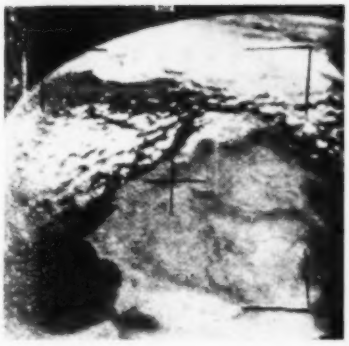
WINNER of the 1961 US National Soaring Championships, held at Wichita, Kansas, during August 1-10, was A. J. Smith, flying an LO-150 (4,564 pts). Runner-up was Bill Ivans in a Slingsby Skylark 3d (4,345 pts), and third was R. Allemann in a Ka-6CR (4,294 pts). The 36 entries included nine of the German Ka-6s and the ex-Philip Wills Skylark flown into tenth place by Gale Abels. There were five contest days during the ten-day competition period.

Richard Schreder (HP-10), who took the lead on the first day, retained it after the second day, dropped to second on the third and regained the lead on the fourth, was unlucky in falling down on the final task, which was an 80-mile race to Salina, Kansas. Ryan in the high-performance Sisu, also, was highly placed prior to the final day. Paul Bikle (Prue Standard) came fourth, and Richard Johnson (Adastra) sixth.

Left, this Temco D-16, seen here at the Leeds/Bradford Airport, Yeadon, has been re-assembled and overhauled by Yorkshire Light Aircraft Ltd. Powered by two 150 h.p. Lycoming engines, the type cruises at 170 m.p.h. and has a still air range of 1,050 miles. Its price is quoted as between £12,000 and £15,000, depending on the equipment fitted. Right, Mr C. M. Leach, managing director of Executair (Nigeria) Ltd, seen with one of the two Piper Apaches purchased by his company and recently flown to Gatwick via the Azores. Based at Lagos, the aircraft will be used for charter operations



SPACE SPECIAL



A "Flight" review of current aspects of spaceflight, with particular reference to the first men in space and the first moves towards Europe in space, and with an introductory contribution from the Minister of Aviation.

No clearer indication of the increasing "pace of space" could be given than our spacecraft scoreboard tables (pages 232-3) which this year list no fewer than 37 craft—four of them manned—compared with fourteen last year.

Just for the record, it is worth noting the total number of spacecraft successfully launched to date—58 Earth satellites, four probes in solar orbit, and one direct hit on the Moon. Thirty-three of these are still in orbit, and at least twelve are still transmitting data.

Aspects of spaceflight activity illustrated on this page are (anti-clockwise from the top): Vostok spacecraft and final stage; Transit 4A with atomic power generator; Shepard's van, seen through fuel-line vapour, arrives at launch pad; Tiros 3 picture of Spain and Portugal; mid-air catch of Discoverer 26 capsule; Gagarin's pre-flight medical; astronauts Grissom, Glenn, and Shepard in Mercury control centre; Blue Scout Jr launch. Left, trail of Grissom's Redstone.

Pictures of Vostok and of Maj Gagarin (and launch-rocket shots on other pages) are from the official Soviet film "With Gagarin to the Stars," distributed by Warner-Pathe

I congratulate "Flight" on this special issue—the first of its kind in which you have been able to contemplate the real possibility of Europe playing an important part in space activities.

Blue Streak is the product of the combined skill and ingenuity of scientists and engineers both in Government establishments and industry. It provides a powerful basis for the development of a versatile launcher capable of putting a wide range of satellites into orbit.

Some of the potentialities of space can be foreseen. Many cannot, for despite the magnificent achievements of the United States and Russia, we are still only at the frontiers of human knowledge in this field.

By building satellite launchers in co-operation we in Europe can, within our own formidable resources both technical and manufacturing, help to push out these frontiers and play our part in exploiting the possibilities which are opening up before the world.

I believe that Europe cannot, if she is to remain in the front rank of engineering technology, afford to leave the exploitation of space exclusively to others; and it is my earnest hope that the Anglo-French proposals for a European organization to develop space vehicle launchers will find wide acceptance.

THE RT HON PETER THORNEYCROFT, *MP*
MINISTER OF AVIATION

SPACE CO-OPERATION IN EUROPE

WITHIN a few weeks, the date and location will be announced of a forthcoming conference of European governments called to plan the framework of Europe's space-launcher programme. The first step will be the formation of a European space-launcher organization—already the initials ESLO have been brought into use—which will as an inaugural project develop the three-stage launch vehicle described on pages 220-226 of this issue.

This move into space by the countries of Europe follows Mr Thorneycroft's international sales tour on behalf of a co-operative vehicle based on Blue Streak, and the subsequent formal discussion of the official Anglo-French proposals to this effect put forward at the Strasbourg intergovernmental conference in February.

Development of the launch vehicle is expected to take about five years, including the provision and launching of three test satellites in order to prove the efficiency of the rocket. Member-countries of ESLO will initially be committed only to this first phase of the co-operative programme, with the question of the real use to which the launch vehicle will be put being left open for the time being. Although there is no shortage of ideas on the possible applications of European satellites and probes, these have not yet been presented as firm proposals.

A comment made in a leading article in *Flight* in February this year is particularly relevant now that West Germany has agreed in principle to the Anglo-French proposals in favour of the formation of ESLO. This stated: "Though there is relief in Britain at the probable rescue of Blue Streak, the difficulties involved in the programme must still be squarely faced. There is the complication of one country developing the first stage, another country the second stage and a group of several others the third. There is the factor of reliability when all three are joined together, even if individually they function well (which at present can be assumed for none of the three). And it is true that a rocket similar to Blue Streak would not be the type which would ideally be developed if Europe were now starting from scratch. This is recognized as part of the restrictive framework which must be accepted if there is to be any programme at all.

"We must not delude ourselves that Europe's space programme will be wholly rational in concept or easy in execution. It remains simply as a workable compromise and a worthy challenge. Eventually, if the peaceful exploration of space is permitted to take place at all, it will be on the basis of global co-operation."

In the scientific field it is recognized that ESLO would co-operate closely with the proposed European Space Research Organization (ESRO), which is concerned with the scientific applications of satellites and space probes as opposed to rocket engineering. There could be advantages (for ESLO, at least) in the two organizations' sharing a European headquarters. On the other hand it is also recognized that ESRO will almost certainly begin its operations by embarking on a short-term programme involving sounding rockets, which could not be supplied by ESLO; and could well follow this with a medium-term programme of modest-size satellites launched by relatively economical rockets such as Scout.

Only after buying sounding rockets and small satellite-launching vehicles elsewhere, then, might ESRO come to Europe's own shop to satisfy its long-term rocket requirements. Nonetheless Europe's scientists are obviously likely customers for the three-stage product of Europe's rocket engineers.

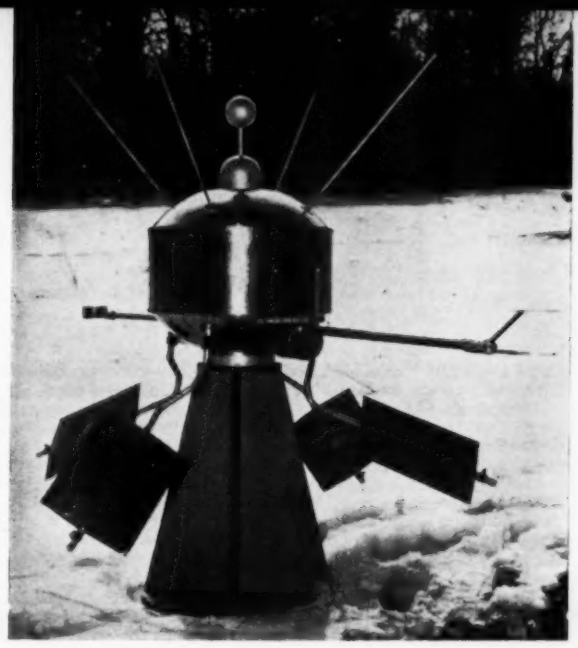
A second likely customer, it was considered at Strasbourg, might be a European communications satellite organization, for which *Flight* might as well accept right away the inevitable abbreviation ECSO. In view of current industry/government projects under way in this field in the United States, the sooner ECSO gets in business the better. The British GPO agreed recently that "the launching of satellites for communications purposes is one of several important uses of a launcher based on the Blue Streak rocket, developed in the way envisaged by the European Launcher Development Organization" (note for the confused: ELDO equals ESLO).

Another obvious future possibility is that the launch-vehicle organization might generate its own requirements in satellite applications. It is envisaged that regular meetings of the governing body of ESLO would be held to decide policy and review progress, at which this type of major change in status—from vehicle-supplier to vehicle-supplier-cum-satellite-operator—could be discussed.

Navigational satellites are clearly on the cards, whoever may be the "operator." Such satellites, in particular, could form a complementary part of the very-low-frequency system being developed at the Royal Aircraft Establishment, Farnborough, for worldwide navigational coverage. Positions taken at intervals from the satellites would be used to cross-check the continuous information supplied by the VLF stations.

For economy-minded Europeans, two techniques by which unit launching costs might be reduced will doubtless be considered. One of these is the multiple shot by which several satellites are placed in orbit (preferably but not invariably their own separate orbits) by one launch vehicle. The second is the "streetcar" or "omnibus" approach in which two or more different pieces of equipment are carried as "passengers" in one satellite. One might envisage, for example, a combined navigation-meteorological satellite which might also carry the pet brainchild of at least one professor of physics.

SPACE DIVERSITY IN BRITAIN



Mock-up of the first joint US/UK satellite. Five are planned

At a time when the countries of Europe are coming together in space as in other spheres, there seem almost as many separate space-minded departments, groups and establishments in Britain as there are countries in Europe. The main difference is that Britain's constituent elements show few signs of coming together. We might not have any satellites in orbit, the message seems to be, but you should see our committees.

Perhaps the major direct space-research project is the first joint US/UK satellite, ionospheric and cosmic-ray experiments for which have been designed and built by university scientists at Birmingham, Imperial College and University College, London. This opportunity to place British experiments in orbit is the result of a generous offer made by the US National Aeronautics and Space Administration, whose Goddard Space Flight Center is providing the satellite structure, complete with telemetry and power sources. NASA will also provide the Scout four-stage, all-solid launch vehicle, and launch facilities at Wallops Station, Wallops Island, Virginia. It is hoped that these facilities will be used in this connection early next year.

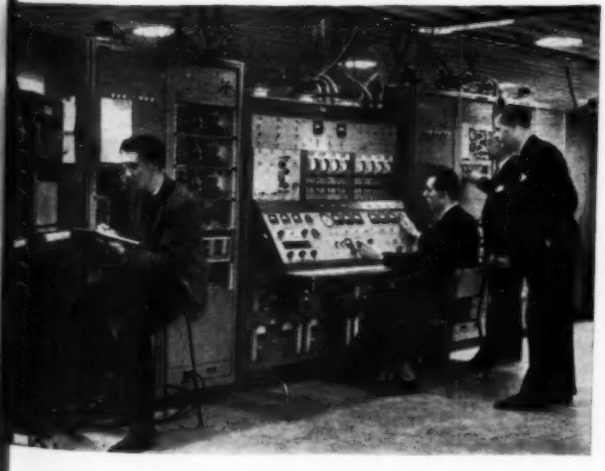
Following the completion of individual test programmes, the first set of British instruments was sent to the USA in June this year. At NASA's Goddard Space Flight Center, Greenbelt, Maryland, the British experiments were integrated into the satellite as a whole, and the complete prototype model is now being subjected to vibration, heat, cold, vacuum and other tests.

Experiments chosen for the second joint satellite were announced last April, and the design of the satellite is now being discussed by teams from both countries. The second satellite is expected to be very similar in layout to the first, as illustrated above.

The British experiments are co-ordinated through the British National Committee on Space Research, which is a committee of the Royal Society with Sir Harrie Massey of UCL as its chairman. Government money for the experiments, however, comes from the Department of Scientific and Industrial Research, which in turn comes under the Office of the Minister for Science, Lord Hailsham. This procedure applies also to a number of other space-oriented investigations by university groups.

The Royal Society is the national body representing Britain in COSPAR, the Committee on Space Research of the International Council of Scientific Unions. In the British national report presented at the recent COSPAR meeting in Florence, the Society explained things this way: "The general 'overseeing' of the scientific content of the whole [British space] programme is the responsibility of the British National Committee on Space Research. This committee reports to the Council of the Royal Society, and advises the Minister for Science through the Space Research Steering Group on scientific aspects."

Equipment at the new Winkfield Minitrack Station, near Windsor



The Department of Scientific and Industrial Research has its fingers in a number of space pies in addition to the joint satellite. Through its Radio Research Station at Slough, which is steadily expanding its own space interests in many directions, the Department now has responsibility for the new Minitrack tracking station at Winkfield, near Windsor. The main building and equipment for this station, worth some £250,000, were supplied on loan by the US Government, who also provided free a teleprinter link between Winkfield and the Goddard Space Flight Center. Personnel of the Radio Research Station operate the Minitrack facility, which came into use at the beginning of this year.

The main Radio Research Station at Slough is the home of World Data Centre C for rockets and satellites, and also provides this country's official satellite-prediction service.

DSIR has also provided money towards the construction and operation of the large steerable radio telescope at Manchester University's Nuffield Radio Astronomy Laboratories at Jodrell Bank, which has played a significant part in tracking many major satellites and space probes. One recent example of Jodrell Bank's work comprised the joint efforts with Russian scientists to trace possible radio signals from the Soviet Venus probe.

The Guided Weapons Department of the Ministry of Aviation's Royal Aircraft Establishment at Farnborough, also, is deep in the space business, both in connection with the development of the Blue Streak launch vehicle and the design of satellites which might conceivably be launched, and in the observation and analysis of satellite orbits. The Radio Department of RAE includes in its work the operation of a Transit satellite tracking station at Lasham Airfield.

Yet another government department has lately become interested, and involved, in space. The General Post Office has been "studying problems associated with communications satellite systems" and in particular is collaborating with the USA in the Relay and Rebound communications-satellite experiments. A ground radio station is being built on the Lizard, Cornwall, in preparation for satellite tests next year. These tests will cover the transmisson of speech, telegraphy and television across the Atlantic.

Private British companies as well as government departments are actively concerned with space affairs. Individual firms have carried out contract work for the Ministry of Aviation, but the main developments over the past year have been the formation of the British Space Development Company, and the collaborative work by Hawker Siddeley Aviation and the French SEREB which led to the formation of the European industrial space study group known as Eurospace. Both organizations now have working groups engaged on specific investigations.

It seems clear that, when Europe really gets into the space business and the air is thick with contracts, there will need to be one national organization or establishment in this country to take all space activity under its wing. Life is hard enough already without competition between the Ministry of Aviation, the GPO and the Office of the Minister for Science; or between the DSIR, the Royal Society, the Government's Steering Group and the universities.

Where might such a civilian space agency or space centre be located? Let us start the ball rolling by suggesting the Royal Aircraft Establishment, Farnborough, with a radio offshoot at the Radio Research Station, Slough.

KENNETH OWEN

GAGARIN

SHEPARD

YURI ALEXEYEVICH GAGARIN is 27. He was born in Gzhatsk district, Smolensk region (in the Russian Federation) on March 9, 1934. His father is a collective farmer. He entered school in 1941, but his schooling was interrupted by the Nazi invasion.

After the war the Gagarin family moved to the town of Gzhatsk, where Yuri continued his studies in secondary school. In 1951 he finished a trade school in the town of Lyubertsky, near Moscow, with honours, qualifying as a foundryman. He finished an evening school for young workers at the same time. From there he went on to an industrial school in Saratov on the Volga, which he finished with honours in 1955.

While attending the industrial school he took up flying in his spare time at the Saratov flying club. After finishing the course at the club in 1955, he studied at a flying school in Orenburg. He has been a flyer since 1957, when he graduated with honours from the Orenburg school. After graduation from the Orenburg flying school as a fighter pilot he served in one of the units of the Soviet armed forces.

On his insistent request he was included in the group of space-flying candidates and successfully passed the selection tests. During the training of the group of space pilots Gagarin was one of the best.

Yuri Gagarin became a member of the Communist Party of the Soviet Union in 1960. His wife Valentina, 26, is a graduate of the Orenburg medical school. They have two girls, Yelena, aged two, and Galya, only one month old at the time of the launch. Yuri's father, now 59, is a carpenter. His mother Anna, 58, is a housewife.

ALAN BARLETT SHEPARD, JR, was born November 18, 1923 in East Derry, New Hampshire. He is married, with two daughters: Julian, 9, and Laura, 13. His parents live in East Derry where the elder Shepard, a retired officer of the US Army, is an insurance broker.

Shepard attended primary school in East Derry and graduated from Pinkerton Academy, Derry, New Hampshire, in 1940. He studied one year at Admiral Farragut Academy, Toms River, New Jersey, and then entered the Naval Academy, Annapolis. He graduated from Annapolis in 1944.

The astronaut saw service on the destroyer *Cogswell* in the Pacific during World War II. He then entered flying training at Corpus Christi, Texas, and Pensacola, Florida. He received his wings in March 1947. Subsequent service was in Fighter Squadron 42 at the Norfolk Naval Air Station and Jacksonville, Florida. He also served several tours aboard aircraft carriers in the Mediterranean. Shepard went to USN Test Pilot School at Patuxent River, Maryland, in 1950 and served two tours in flight-test work.

Between his flight-test tours at Patuxent, Shepard was assigned to Fighter Squadron 193 at Moffet Field, California, a night-fighter unit flying Banshee jets. He was Operations Officer of this squadron and made two tours with it to the Western Pacific on board the carrier *Oriskany*. He has been engaged in the testing of the F3H Demon, F8U Crusader, F4D Skyray, and F11F Tigercat. He was project test pilot on the F5D Skylancer. After his graduation from the Naval War College, Shepard joined the staff of the Commander-in-Chief, Atlantic Fleet, as aircraft readiness officer. He has 3,700hr of flying time, 1,800 in jets.

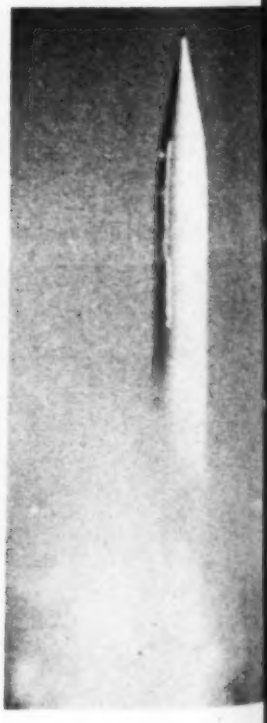
THE YEAR OF THE ASTRONAUTS

THIS century has known no day more momentous than Wednesday, April 12, 1961. With the orbital flight of Maj Yuri Gagarin, space became operational, and man's thinking was jerked into a wider, unfamiliar realm. In a year when the successful orbit and recovery of an Earth satellite may rate only one sentence in the mass-circulation newspapers, and at a time when the pioneer astronaut has come to be regarded by some primarily as a political figure and not as the world's first space pilot, it is as well to remind ourselves of the significance of '61. This is history, and we are privileged to be here to see it made.

Space history moves fast, and news of the latest achievement—man in orbit for over 24 hours—came even as this issue was being prepared, less than four months after Gagarin's premier orbit. As we close for press, there are four names on the roll of space pilots: Gagarin, Shepard, Grissom and Titov. In their respective log books are 1hr 48min orbital flight; 15min ballistic flight; 16 min ballistic flight and 25hr 18min orbital flight. The four astronauts, their spacecraft, and the programmes leading up to their flights into space form the subject of this article, which is compiled from official American and Soviet sources.

The flight phase of the Soviet man-in-space programme leading up

Right, launch from Baykonur, April 12; left, from Cape Canaveral, May 5



GRISSOM

TITOV

VIRGIL IVAN GRISSOM was born April 3, 1926 in Mitchell, Indiana. He is 5ft 7in tall, weighs 150lb, has brown hair and brown eyes. Mrs Grissom is the former Betty L. Moore. They have two sons: Scott, 11, and Mark, 7. Grissom's parents, Mr and Mrs Dennis D. Grissom, live at 715 Baker Street, Mitchell. He has two brothers and a sister.

Grissom attended primary and high schools in Mitchell. He first entered the Air Force in 1944 as an aviation cadet and was discharged in November 1945. He graduated from Purdue University with a degree in mechanical engineering in 1950. He returned to aviation cadet training after his graduation from Purdue and received his wings in March 1951. Grissom joined the 75th Fighter-Interceptor Squadron at Presque Isle, Maine, as an F-86 fighter pilot. He flew 100 combat missions in Korea in F-86s with the 334th Fighter-Interceptor Squadron.

He left Korea in June 1952 and became a jet pilot instructor at Bryan, Texas. In August 1955 he went to the Air Force Institute of Technology at Wright-Patterson Air Force Base, Ohio, to study aeronautical engineering. In October 1956 he attended the Test Pilot School at Edwards Air Force Base, California, and returned to Wright-Patterson Air Force Base in May 1957 as a test pilot assigned to the Fighter Branch. He has flown more than 3,400hr, over 2,500 in jets.

Grissom has been awarded the Distinguished Flying Cross and Air Medal with Cluster for service in Korea. His hobbies are hunting and fishing.

In Project Mercury, Grissom's specialization comprised the reaction control system and autopilot of the capsule.

HERMAN STEPANOVICH TITOV was born in 1935 in the village of Verkhneye Zhilino, Kosikha district, Altai region of Siberia, in the family of a teacher. He is of Russian nationality.

He studied at the Nalobikhino secondary school of the same district in the Altai region. From 1955 to 1957 he was a cadet at the Stalingrad Air Force Pilot's School, from which he graduated in the first category and passed his pilot's examinations with distinction. After graduation he was sent to serve in the Leningrad military district.

Herman Titov is a candidate-member of the Communist Party of the Soviet Union, and is married. His wife, Tamara Vasilyevna, was born in 1937. The cosmonaut's father, Stepan Pavolvich, born in 1910, taught Russian language and literature and the German language in a seven-year school in the Altai region. Stepan Pavolvich has been a pensioner since 1961. The cosmonaut's mother, Aleksandra Mikhailovna, was born in 1914.

In 1943 Herman Stepanovich Titov entered primary school of the May Morning collective farm in Kosikha district, where his mother had moved at the beginning of the war. In 1950 he finished his schooling at the seven-year school in the same district. In 1949 Titov entered the Young Communist League. In 1953 he entered the military aviation school for preliminary flying training. For his successes in combat training and socialist preparation, and for exemplary military discipline, the Leningrad District Committee of the Young Communist League awarded him two certificates of merit.

Parachute drops from aircraft formed part of the specialized cosmonaut training of both Titov and Gagarin.

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to Gagarin's April 12 orbital flight began in earnest on May 15, 1960, with the launch into orbit of Sputnik 4, alias Spaceship Satellite 1. This was the first of five preliminary orbital shots with planned recovery, of which the latter phase of two were unsuccessful. Russia's concentration on the goal of man in orbit was interrupted only for the orbital launch of the Venus probe, successfully effected last February with Sputnik 8 and believed attempted earlier that month with Sputnik 7. The series was as follows:—

1960

May 15. Spaceship satellite 1 (Sputnik 4). First orbit by heavy satellite (10,008lb, including 3,250lb scientific instrumentation) with object of proving systems guaranteeing man's life functions during flight. Orientation fault caused change into higher orbit, not re-entry, on firing retro-rocket.

August 29. Spaceship satellite 2 (Sputnik 5). First successful recovery from orbit of heavy spacecraft containing animals. Object, proving recovery systems and systems securing man's life activity; recording of cosmic radiation levels; investigation of solar shortwave radiation; medical and biological investigations.

December 1. Spaceship satellite 3 (Sputnik 6). Same object as August 19 launch. Craft descended on unplanned trajectory when signalled to re-enter, and burned up in dense atmosphere.

1961

March 9. Spaceship satellite 4 (Sputnik 9, possibly *Vostok*). Further test of spacecraft and systems for manned flight, carrying animals. Successful recovery.

March 25. Spaceship satellite 5 (Sputnik 10, possibly *Vostok*). Further test of spacecraft and systems for manned flight, carrying animals. Successful recovery.

April 12. *Vostok* (Spaceship satellite 6, or Sputnik 11). First manned orbital flight by Maj Yuri Gagarin. One complete orbit, duration 108 min. Successful recovery.

August 6. *Vostok 2* (Spaceship satellite 7, or Sputnik 12). Orbital flight by Maj Herman Titov. Seventeen complete orbits, duration 25hr 18min. Successful recovery.

The basic *Vostok* spacecraft was described in *Flight* of May 4, 1961. Additional details of its cabin equipment and technique of re-entry, presumably identical on both *Vostok* and *Vostok 2*, have been officially outlined thus:—

For descent in a predetermined area, an exact orientation in space must be given to the spaceship-satellite before the retro-engine is switched in. This problem is solved with an orientation system. In the given flight, one of the axes of the spaceship was oriented towards the Sun. The sensitive elements of this system are a series of optical and gyroscopic sensors. The signals which they generate are transformed in an electronic unit into commands for the system of organs of control.

The orientation system ensures automatic location of the Sun, corresponding rotation of the spaceship, and its maintenance in the desired position with great accuracy. After the spaceship is oriented, the retro-engine switches in at the appropriate moment. Commands for switching in the orientation system, retro-engine and other systems, are given by an electronic programming device.

For measuring the orbital parameters of the spaceship-satellite and controlling the work of the equipment on board, it carries radio-measuring and radio-telemetry apparatus. Measurement of the orbital parameters and the reception of telemetric information are accomplished by stations on the territory of the USSR. The measurement data is automatically transmitted along communication lines to calculating centres, where it is processed with electronic computing machines. Thus, during the flight, information about the basic orbital parameters is operationally received, and the future motion of the spaceship is predicted.

On the spaceship also is a "Signal" radio system working on a frequency of 19.9995Mc/s. This serves for the radio-location of the spaceship and the transmission of part of the telemetric information. The television system transmits to Earth the picture of the cosmonaut, permitting visual monitoring of his condition. One of the television cameras transmits the cosmonaut's picture full-face, and the other in profile.

Two-way communication of the cosmonaut with the Earth is effected by a radio-telephone system working in the short-wave range (9.019 and 20.006Mc/s) and the ultra-short-wave range (143.625Mc/s). The ultra-short-wave channel is used for communication with ground stations at distances up to 1,500-2,000km. Short-wave communication with ground stations on the territory of the USSR may be secured, experience has shown, over a great part of the orbit.

The radio-telephone system includes a tape recorder, permitting the cosmonaut's speech to be recorded in flight and later reproduced

YEAR OF THE ASTRONAUTS . . .

and transmitted during the spaceship's flight over ground receiving stations. Radio-telegraphy by the cosmonaut is also possible.

In building the cosmic spaceship special attention was paid to ensuring the safety of flight. The launches of the first Soviet spaceship-satellites confirmed the high reliability of their apparatus and equipment. However, a series of supplementary measures were taken on the spaceship *Vostok* with the aim of excluding the possibility of any accident and of guaranteeing a safe flight for the man in it. Such an attitude is fully in accord with the main task, that of creating hardware enabling man to venture into cosmic space with confidence.

Finally, the construction of the spaceship permits descent to the Earth even in the case of failure of the retro-engine, by means of natural braking in the atmosphere. Supplies of food, water, regenerating substances, and the capacity of the sources of electrical energy, are sufficient for ten days' flight. The construction of the spaceship includes measures to prevent the cabin temperature from rising above a certain limit, despite the prolonged heating of its surface arising from the gradual braking of the spaceship in the atmosphere.

Launch-pad Scene. On the occasion of the *Vostok 2* flight, Press reports included an eye-witness account of the launch-site scene—the first such description of any Soviet space launch—written by Tass special correspondent Alexander Romanov:—

It is hot. Our car devours kilometre after kilometre of the smooth macadamized road. Villages, towns, high-tension pylons flash by. Suddenly at a turn, in the distance there looms up a kind of filigree construction. Coming nearer we begin to discern through the maze of steel the slender cigar-shaped body of a multi-stage rocket.

Tremendous girders carefully but firmly cradle it, as if afraid that it may break loose into the sky without the permission of its creators. This is the launching pad.

There are men all over the construction surrounding the spaceship. Time and again terse commands come over the public-address system. The last preparations for the flight are under way.

An elevator cabin runs down from the top of the rocket and on to the launching pad there steps out a middle-sized fellow in a checked, dark blue shirt tucked into light grey trousers. Quickly running down a ladder, he came up to the group surrounding the chief designer, the man in whose hands converge all the threads in preparing the celestial journey.

We would probably have never paid any attention to the boy in the dark blue shirt, who looked like any other worker, had not the man next to me whispered: "That is the cosmonaut—Herman Stepanovich Titov."

By evening all the work had been finished, and we saw the spaceman again. Wearing a flying suit, he was surrounded by comrades who were getting the spaceship ready for its long journey. . . .

Herman spoke warmly and sincerely. He thanked his comrades for their good wishes and said he was proud of the trust placed in him and promised to come to the cosmodrome and tell them about the flight on his return to Earth.

On the morning of August 6, the Sun, burning hot over the steppe, lit up the silver spaceship, the cosmodrome, and the flowers growing beside the pavement. Members of the Government commission, distinguished Soviet scientists, designers, engine testers and the staff of the launching command assembled at the command post.

The chairman of the commission opens the meeting, the last before the spaceship's flight. The reports are terse to the extreme. Their meaning could be expressed in one or two words: "Everything is ready for the flight." The State commission names the moment for launching. The launching area is cleared, only essential staff remain.

Here comes the light-blue bus carrying the spaceman. Titov alights, crosses to the launching area and the lift takes him up to his cabin. He is wearing an orange-coloured flying suit with "USSR" written on it, and walks rather clumsily. The flying suit, of course, is not for strolling on Earth. Under the suit are various transmitters, which will send back information about the pilot's physical condition.

Having said goodbye to his friends—future cosmonauts—Herman Titov walks to the lift. . . . The chairman of the commission, scientists and the chief designer shake the pilot firmly by the hand, embrace him and wish him a successful flight. Herman ascends the stairway to the platform where the lift is situated and addresses those assembled below, and all the Soviet people. He says that he will fulfil with honour the task which has been entrusted to him by the party and the Government.

All those on the cosmodrome warmly applauded him. We see Titov enter the cabin. The command "Take off" will be given shortly. . . .

Titov was then brought a small book, bearing on its cover the words "Log book of the Spaceship Vostok 2." A pencil is attached to the cover and the cosmonaut checks that it is firmly fixed, so that it will not be lost during the state of weightlessness.

Yuri Gagarin did not attach his pencil firmly and lost it. Yuri found it afterwards, Titov laughs. . . .

To observe the spaceship take-off we go to a special square about a mile from the launching place, but we are not cut off from what is happening on the spaceship. The radio brings the final commands.

Ten minutes to go . . . the chairman of the State Commission asks the cosmonaut how he feels. "I feel wonderful, wonderful," he says. "Thank you for your attention." Five minutes to go . . . and at last, in the silence, rings out the last command: "Take-off."

From a distance we can see the silver rocket, already completely free from the supporting gantry. Another second, exactly 0900, and the rocket—propelled by some unbelievable, miraculous force—slowly, it seems very slowly, leaves the Earth.

Gathering force, it streaks more and more quickly upwards, like a roaring fiery globe. At this moment it seems that two Suns are shining on the Earth. At a comparatively low height the spaceship inclines to the side and flies on its set course into orbit . . .

United States Programme. Turning to the American programme, an extensive series of flight tests of the Mercury capsule and its systems preceded the manned sub-orbital flights of Shepard and Grissom earlier this year. The complete series included the following major shots:—

1959.

September 9. Big Joe. NASA-produced research and development capsule, launched by Atlas from Cape Canaveral to test validity of the Mercury concept. Capsule survived high heat and air loads and was successfully recovered.

October 4. Little Joe 1. Fired at NASA Wallops Station, Wallops Island, to check matching of booster and spacecraft. Launch vehicle comprised eight solid-propellant rockets producing 250,000lb thrust.

November 4. Little Joe 2. Evaluation of the low-altitude abort conditions, from Wallops Station.

December 4. Little Joe 3. Test of high-altitude performance of the escape system, carrying rhesus monkey Sam as test subject, from Wallops Station.

1960.

January 21. Little Joe 4. Evaluation of escape system under high air loads, carrying rhesus monkey Miss Sam as test subject, from Wallops Station.

May 9. Beach abort test of capsule 1. First McDonnell production capsule and its escape rocket system were fired in an off-the-pad abort escape-rocket test at Wallops Station.

July 29. Mercury-Atlas 1 (capsule 4). This was the first Atlas-boosted flight, aimed at qualifying the capsule under maximum airloads and afterbody heating rate during re-entry conditions. The capsule contained no escape system and no test subject. The shot, from Cape Canaveral, was unsuccessful because of a booster system malfunction.

November 8. Little Joe 5 (capsule 3). From Wallops Station, to check the production capsule in an abort simulating the most severe Little Joe booster conditions. The shot was unsuccessful.

November 21. Mercury-Redstone 1 (capsule 2). This was the first unmanned Redstone-boosted flight, but premature engine cut-off activated the emergency escape system when the booster was only about 1in off the pad. The booster settled back on the pad at Cape Canaveral and was damaged slightly. The capsule was recovered for re-use.

December 19. Mercury-Redstone 1A (capsule 2). This Cape Canaveral shot was a repeat of the November 21 attempt and was completely successful. The capsule reached a peak altitude of 135 miles, covered a horizontal distance of 236 miles and was recovered successfully.

1961.

January 31. Mercury-Redstone 2 (capsule 5). Carrying chimpanzee Ham, the capsule reached an altitude of 155 miles, landed 420 miles downrange from Cape Canaveral and was recovered. During the landing phase the parachuting capsule was drifting as it struck the water. The impact forced the suspended heat shield against a bundle of potted wires, which drove a bolt through the pressure bulkhead, causing the capsule to leak. Ham was rescued before the capsule had taken on too much water.

February 21. Mercury-Atlas 2 (capsule 6). Made to check maximum heating and its effect during the worst re-entry design conditions, this shot achieved an altitude of 108 miles. The re-entry angle was higher than planned and the heating was correspondingly more severe than anticipated. It landed 1,425 miles downrange from Cape Canaveral. Maximum speed was about 13,000 m.p.h., and the shot was successful.

March 18. Little Joe 5A (capsule 14). A repeat of the unsuccessful Little Joe 5, this Wallops Station shot was only marginally successful.

April 25. Mercury-Atlas 3 (capsule 8). An attempt to orbit the capsule from Cape Canaveral with a "mechanical astronaut" aboard. 40sec after launch the booster was destroyed by radio command given by the range safety officer. The capsule was recovered and is to be used again.

April 28. Little Joe 5B (capsule 14). This was the third attempt to check the escape system under the worst conditions, using a Little Joe fired from Wallops Station. The capsule reached 40,000ft in a completely successful shot.

May 5. Mercury-Redstone 3 (capsule 7). Astronaut Alan B. Shepard was carried on a ballistic flight-path reaching peak altitude of 115 miles and downrange distance of 302 miles from Cape Canaveral. The flight was successful.

July 21. Mercury-Redstone 4 (capsule 9). Astronaut Virgil I. Grissom carried on ballistic flight-path reaching peak altitude of 118 miles and downrange distance of 303 miles from Cape Canaveral. The flight was successful and the astronaut was recovered safely, but the capsule sank and was not recovered.

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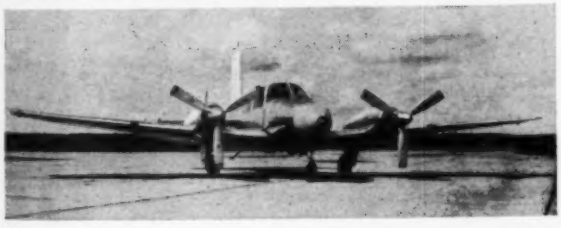

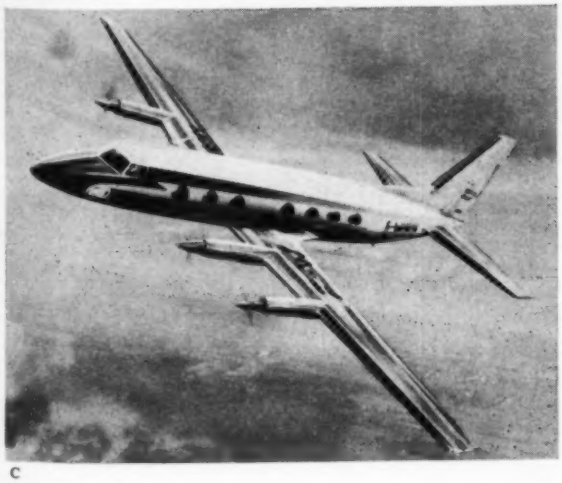

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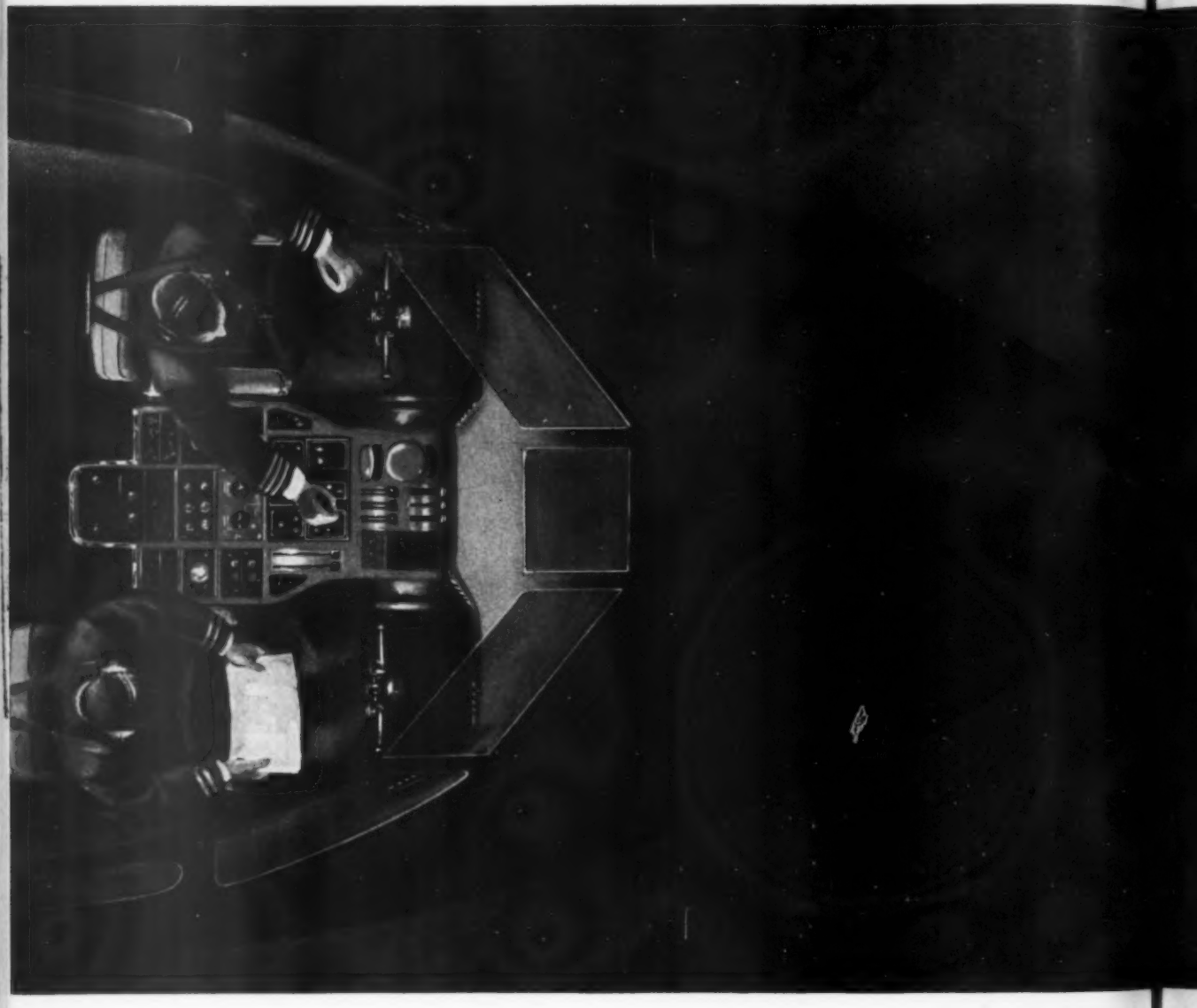

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...approach . . .

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automatically

Here is a brief factual report of SMITHS achievements in this field up to the beginning of this year:

SMITHS have been making automatic pilots since 1933.

SMITHS designed and made the first British electrically operated automatic pilot.

SMITHS designed and made the automatic pilot used in the world's first turbo-jet and turbo-prop airliners.

SMITHS automatic pilot (and associated equipment) is the heart of the world's first *fully automatic landing equipment* to go into production. This is the 'Autoland' system, in the design of which SMITHS collaborated closely with the Blind Landing Experimental Unit of the Royal Aircraft Establishment. The 'Autoland' system has been adopted by the Royal Air Force.

SMITHS automatic landing equipment has, in the last ten years, carried out more successful automatic landings than *all* other known systems in the world added together.

SMITHS embarked five years ago on a new generation of automatic pilots, designed to increase the safety factor to a level that will meet the stringent safety requirements that the civil air lines need for automatic landing.

SMITHS latest-generation automatic pilots will be the heart of the automatic system to be fitted in the de Havilland 'Trident' (under construction for BEA) and the Short 'Belfast' heavy freighter (on order for RAF. Transport Command). Negotiations are in progress with other operators.

SMITHS automatic landing equipment has been ordered by the US Federal Aviation Agency for evaluation tests in America.

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YEAR OF THE ASTRONAUTS . . .

Flight's description of Cdr Shepard's ballistic flight was contained in our issues of May 11 and May 18. The interior of the Mercury spacecraft has been described in typical detail by the National Aeronautics and Space Administration in these terms:—

Instrument Panel. Instruments are located on a main instrument panel, a left console, and a right console. The main panel is directly in front of the pilot. Navigational instruments are located in the left and centre sections of the panel and the periscope is located in the centre. The right section of the main panel is composed of environmental system indicators and controls, electrical switches, and indicators and communication system controls. The left console includes sequencing tele-lights and warning panel, indicators and controls for the spacecraft's automatic pilot (ASCS), environmental control and landing systems. All told there are well over 100 lights, fuses, switches and miscellaneous controls and displays.

Periscope. Approximately 2ft in front of the pilot is located the Earth periscope which provides a 360° view of the horizon. The pilot may manually adjust for low or high magnification. On "low" he will have a view of the Earth of about 1,900 miles in diameter; on "high" the field of view will be reduced to about 80 miles. Altitude can be measured within ±10 nautical miles. The Mercury Earth periscope will, in addition, serve as a navigational aid.

Pilot Support Couch. The astronaut's couch is constructed of a crushable honeycomb material bonded to a glass-fibre shell and lined with a rubber padding. Each astronaut has a couch contoured to his specific shape. The couch is designed to support the pilot's body-loads during all phases of the flight and to protect him from the acceleration forces of launch and re-entry.

Restraint System. The pilot restraint system, which consists of shoulder and chest straps, leg straps, a crotch strap, lap belt and toe guards, is designed to restrain the astronaut in the couch during maximum deceleration.

Environmental Control System. The environmental control system provides the Mercury spacecraft cabin and the astronaut with a 100 per cent oxygen environment to furnish breathing, ventilation, and pressurization gas required during the flight. The system is completely automatic but, in the event the automatic control malfunctions, manual controls can be used.

The system consists of two individual control circuits, namely the cabin circuit and the suit circuit, which will normally operate for about 28hr. Both systems are operated simultaneously. The suit circuit is simply isolated from the cabin circuit by the astronaut closing the faceplate on his helmet. Unless there is a failure in the cabin circuit causing loss of pressure, the pilot's pressure suit will not be inflated.

Aeromedical Information. Throughout the flight the physical well-being of the pilot is monitored. The pilot's respiration rate and depth, electrocardiogram, and body temperature are telemetered to flight surgeons on the ground.

Main Battery System. Three 3,000-watt-hour batteries and one 1,500-watt-hour battery are connected in parallel to provide power for the complete mission and about a 16hr post-landing period. A standby back-up power system of 1,500-watt-hour capacity is also provided. To further ensure reliable operation of the pyrotechnic system, each device has a completely isolated power feed system.

Cameras. A 16mm camera is installed to the left of the astronaut's head to photograph the instrument-panel display from launch through recovery. A pilot observer camera is mounted in the main instrument panel and is also operated from launch through recovery.

Clock. There is a clock in the spacecraft with three major separate operational components; (1) a standard aircraft-type elapsed time clock, (2) a "seconds from launch" digital indicator with a manual reset, and (3) a time-delay relay which is to initiate the retrograde fire sequence. When the preset time has passed, the relay closes and actuates the retrograde fire signal, at the same time sending a telemetered signal to the ground.

Altimeter. The Mercury barometer altimeter is a single-revolution indicator with a range from sea level to 100,000ft. The dial face has reference marks at the drogue and main parachute deployment altitudes.

At the top right corner of the main panel are located environmental displays, providing the pilot with readings of cabin pressure, temperature, humidity, and oxygen quantity remaining.

Survival Equipment. A survival kit on the left side of the pilot's couch contains a personnel parachute which may be used as a third parachute back-up for use in an extreme emergency. The survival package also contains a one-man life raft, de-salting kit, shark repellant, dye markers, first-aid kit, distress signals, a signal mirror, portable radio, survival ration, matches, a whistle, and 10ft of nylon cord. Although not expected to be needed in Redstone flights, it is the same kit as will be carried in the orbital flights.

On the booster side, the Mercury-Redstone used as the initial launch vehicle in the manned phases of the Mercury programme is a departure from the original Redstone design. Some 800 changes were required to transform the old Redstone into what NASA describe as a "modern, man-carrying powerplant."

In the re-design of the rocket, its 70in diameter tank section was lengthened by about 6ft, increasing the burning time by more than 20sec. This brought the length of the vehicle, including spacecraft and escape tower, up to 83ft and its weight to 66,000lb. Major changes in the engine were made to enhance reliability. These included provisions to allow for the increased burning time, and improvements in the peroxide system which drives the fuel and liquid oxygen pumps and provides thrust control.

Other modifications improved the engine's stability and added an anti-fire-hazard system. The Mercury-Redstone engine, developed and built by Rocketdyne, generates a thrust of 78,000lb. Also added were a new instrument compartment, a completely automatic emergency sensing system, and a spacecraft adapter.

"I USED TO FLY PLANES" — GAGARIN ON GAGARIN

WHEN the first Soviet artificial satellite of the Earth was launched I was finishing the Orenburg flying school. My schoolmates and I learned about this event after our flying exercises in Migs that very same day. We were very proud of the great achievement of Soviet science and engineering. It was clear that before long a human being would fly into space. And yet I thought it would probably be another ten years. However, it took less than four years. Of course, at that time I, too, wanted to fly to outer space, but it never occurred to me that I might be precisely the one to fly the first spaceship.

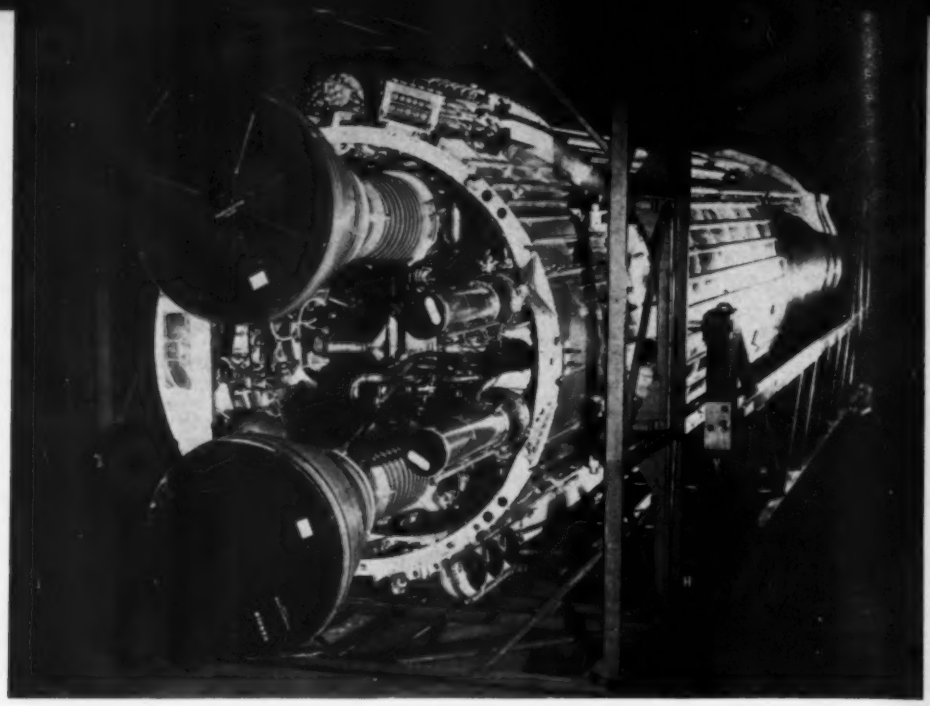
I HEARD the name of Tsiolkovsky for the first time when I was still a schoolboy. When I attended the trade and industrial schools I learned to love this name. I studied Tsiolkovsky's works. I must say that in his book *Outside the Earth* Tsiolkovsky very clearly foresaw all that I chanced to see with my own eyes during my flight. Tsiolkovsky, like no one else, had a clear idea of the world as it appears to a person in outer space.

I LIKE many writers, both Soviet and classic. I am very fond of reading Chekhov, Tolstoi, Pushkin and Polevoi. My most favourite literary character, the one I learned to love when I was still a boy, is the main character in Boris Polevoi's book *A Story About a Real Man*. I regret very much that I have never had the chance of meeting Maresyev. I also read Jules Verne. Of course, his books are very interesting, but life proved things to be different. Ivan Yefremov's novel *Andromeda* is good and I liked it. However, since I have been in outer space I realize that not everything in this book is true to fact. But it is useful just the same.

MY favourite occupation? I like flying best. I used to fly planes, but I like my space flight best of all. Can my first flight in an aircraft be compared with my flight of yesterday? It is hard to compare them. The former was a flight in a winged craft; the latter, in a wingless one. The plane flew at a speed of 150km/hr; the spaceship, 28,000 km/hr. The former flew at an altitude of 1,500 metres; the latter, 300km.

IN the summer of 1960 I joined the Party. This was the greatest and most memorable event in my life prior to my space flight. I dedicate my flight to our Party, our Government, the 22nd Congress of the Party, all our people who are marching in the forefront of humanity and are building a new society.

I WANT to devote my life, my work, all my thoughts and feelings to the new science of the conquest of space. I should like to go to Venus to see what is under that planet's veil of clouds; I should like to visit Mars, to see for myself whether there are any canals on it. The Moon is not so distant a neighbour of ours and I don't think it will be very long before we can fly to the Moon and land on it.



A Blue Streak on its handling frame, about to leave the de Havilland Aircraft plant at Stevenage

Europe's Heavy Launcher

—WITH BLUE STREAK AS THE FIRST STAGE

By the Technical Editor

TODAY it increasingly appears to be a perilous decision for any technologically advanced nation to elect to take no part in the exploration of space. Previous writers have seen parallels in the exploration of our own globe, the way in which man has learnt to navigate the seas and the atmosphere, and other areas in which it appeared that sufficient money, sweat, courage and persistence might win rich prizes. Spaceflight is a unique activity: it promises substantial cash returns, it is singularly important to a nation's prestige, and it is one field above all others in which any accomplishment gradually filters down to the ultimate benefit of all industries.

In comparison with terrestrial flight it appears fantastically expensive. Many taxpayers may feel that any spaceflight expenditure could be better spent on schools, hospitals and similar benefits to all mankind. It is difficult not to incline towards the plausible argument that research for the improvement of all technologies should be undertaken directly; in other words, if an industry wants a better closed-loop servomechanism, why try to obtain it as a by-product from space exploration? Such considerations have been debated by scientists, politicians and engineers throughout Europe during the past year; and their conclusion is almost certain to be an agreement to embark on an international heavy-launcher programme.

Until now nearly all space exploration has been carried out by two nations, working independently. They have been able to accomplish so much because of their immense technological strength; but the European nations have a greater population than either the USA or the Soviet Union, and most of them are competent in all fields of advanced technology. Together they should be capable of doing anything the two giants can do, and space exploration must be one of their first major challenges as a team.

In this special issue of *Flight* it is appropriate that a description should be presented of Europe's first heavy launcher. Such hardware is among the most expensive of all man's creations; and most of it goes up and never comes down again (or burns up on re-entry, which amounts to the same thing). It follows that its design, manufacture, inspection and test must be such as to achieve standards of component reliability unattempted in less exotic vehicles. Any engineer will appreciate that the way to reliability is to use and develop one design *ad infinitum*, and never to alter it unless absolutely necessary. The last thing one should do is to embark on a new design.

This being so, it would appear that the obvious course of action for any nation wishing to place a satellite in orbit is to approach one of the giants and say "please, may we have one of your highly developed launch vehicles?" But this would prevent that nation from acquiring the essential experience which can be acquired only by doing. And, as these words are written, it appears almost certain that the nations of Europe are going to "get their feet wet," as British industry would say.

Initially (i.e., 1961 to beyond 1966) they are going to get their feet wet with a three-stage vehicle of essentially conventional and conservative design. The first stage will be the Blue Streak, originally designed in Britain as a military weapon. The second stage will be French, and although it will lean heavily on experience gained with Véronique it will be a largely new design. The third stage is just a gleam in eyes of many nationalities. The European heavy launcher may well appear with several different upper stages, either brought in by new countries or because it is in this region that high-energy propellants are most rewarding.

It is impossible to say much about non-existent upper stages; but this journal is proud to reveal quite a lot about the first stage. Previously classified as a military secret, the design of Blue Streak is such that it should provide a solid foundation on which Europe can build a spaceflight programme. It is not quite the vehicle which would today be drawn on a clean sheet of paper to fulfil the same function; but it exists, and its ground equipment and installations exist, and it is doubtful that any newer first stage could ever show an overall economy.

Blue Streak was originally a long-range ballistic missile. During 1954 the Ministry of Supply formulated a specification suited to the requirements of RAF Bomber Command and various overseas commitments, and the basic figure seems to have been a range of about 2,500 to 3,000 miles with a thermonuclear warhead. The missile was to be capable of deployment in underground silos, and the use of cryogenic propellants was accepted. By April 1955 the industrial team had been chosen: de Havilland Propellers, prime contractor; de Havilland Aircraft, airframe; Rolls-Royce, propulsion; and Sperry Gyroscope, inertial guidance system.

From the outset it was agreed that propulsion would have to be effected by engines broadly similar to those developed carefully over many years by the Rocketdyne division of NAA, and in August 1955 Rolls-Royce announced a technical agreement with the US company. Preliminary studies with the airframe indicated that complete trajectory freedom would be impossible with a light-alloy structure able to withstand only some 250°C, and the additional 400°C allowed by the use of stainless steel appeared well worth while. The de Havilland designers therefore decided to employ balloon tankage, of the type pioneered by Convair (now General Dynamics/Astronautics) with the Atlas ICBM; and, although not announced

at the time, an agreement with the San Diego firm was concluded in 1957, when the design was well advanced. The flow of information between the two countries has not been all one-way. The Blue Streak team gradually became self-supporting, and able to hand out a great deal of information themselves. Their work is still proving of value to US programmes; for example, as this journal reported on June 29, Blue Streak research on firing from the bottom of silos has been of direct benefit to Titan 2.

As might be expected, the development of Blue Streak as an LRBM was very much a full-time job; sometimes a day and night job. But many engaged in the work were interested in space research, and in their spare time studied the British vehicle as a satellite launcher. Once Sputnik 1 had been launched in October 1957 this work became open and official, and during 1959 a combination of Blue Streak with Black Knight as a second stage was investigated in detail. Much work was also carried out with specially designed second and third stages, as reported in *Flight* for February 17 last.

In April 1960 the Minister of Defence announced that a deterrent based on fixed sites was no longer good value for money, and that Blue Streak as a weapon was being terminated. At one stroke this made the satellite studies dominant. It is fortunate that, had Blue Streak been specifically designed for the sole purpose of placing payloads in orbit, it would differ hardly at all from the LRBM cancelled 16 months ago. The greatest problems were not technical but financial and political.

The Minister of Aviation very soon satisfied himself and the British Government that Blue Streak as a satellite launcher was a good idea; and he assumed the difficult role of travelling salesman for the entire project throughout Europe and the Commonwealth. The big questions were whether Britain could go it alone; whether we should work with Europe, or with the Commonwealth or both; to what extent assistance should be sought from the United States; and whether either Blue Streak or the whole idea of spaceflight should be abandoned. Door-to-door hawking across the face of the Earth, and at ministerial level, takes time; but it was soon evident that, apart from Australia, the Commonwealth countries were not prepared—or could not afford—to come in.

But in Europe Mr Thorneycroft's words did not fall on deaf ears. Last winter a preliminary agreement was reached with France, covering the first two vehicle stages and outlining a possible programme which could be completed by the addition of a suitable third stage. These proposals were put forward jointly by the two nations at Strasbourg during the week January 30 to February 3 last. The audience was made up of technical and diplomatic representatives from West Germany, Italy, Spain, Sweden, Belgium, The Netherlands, Switzerland, Denmark, Austria and Norway. According to the British and French hosts, the overall cost of the proposed initial programme to develop a three-stage launcher would be of the order of £70m, spread over five years. Finance would be provided by all the members of the suggested European Launcher Development Organization, on a basis having regard to each state's national income; and contracts would be placed to ensure a "rational distribution of work" among members.

Yet to be resolved are the detailed engineering and mating of the second stage to the first, the design of the third stage, the payloads to be carried, and the overall objects of the exercise, i.e., the order in which the many possible scientific and commercial programmes shall be attempted. There is already a nearly operational launch facility at the Weapons Research Establishment in Australia; but the members of the European Launcher Development Organization will have to decide whether it shall be used, and if so on what basis.

Meanwhile, the huge industrial team that brought the first stage close to the start of flight trials in April 1960 has not been allowed to break up. Some major contractors—Sperry in particular—have had to leave the programme, owing to the fact that their contribubution was necessary for a weapon but not for a satellite launcher; but D.H. and Rolls-Royce have preserved a substantial Blue Streak staff. During the past 12 months all work has been financed directly by the MoA, whose own experts at the RAE have played a leading part, and much has been accomplished since April 1960. The original prime contractor ceased to exist last September, as a result of merging with de Havilland Aircraft; and since January 1960 the whole de Havilland enterprise has been part of Hawker Siddeley Aviation. Having thus filled in the background, attention can be turned to Blue Streak itself.

BLUE STREAK IN DETAIL

From the bottom, Blue Streak's airframe consists of a propulsion bay, a short stress-diffusion section, the kerosine (K) tank, the liquid-oxygen (Lox) tank and the new transition section, or separation bay, mating with the French second stage. This bay is not yet finalized, since certain inter-stage design features have yet to be agreed.

In general, the construction of the propulsion bay follows conventional light-alloy aircraft practice. The skin is supported on a riveted structure of internal frames and stringers, and longitudinal channel and Z sections riveted along the exterior. The two engines are hung on a pair of large I-beams. The ruling material in the propulsion-bay structure is L.72, but the booms of the two motor beams are high-strength DTD.363. A transverse truss bridge fabricated in light-alloy tube bears the loads from the thrust-chamber pitch actuators, and an additional suspension, consisting of a tie-girder pin-jointed to a tubular member, hangs from the motor beams and carries the pair of engine turbopumps. On either side of the bay large pannier fairings form hinged doors over the gaseous-nitrogen (GN) bottles, autopilot and telemetry equipment, and provide aerodynamic fairings ahead of the motor effluxes.

At each end of both motor beams is an upper and lower anchorage fitting. The four lower fittings support the weight of the vehicle on the launcher, and withstand the thrust of the mainstage during the period of hold-down between engine-start and release of the launcher clamps. The four upper fittings are the only structural connection between the propulsion bay and the tank section and upper stages above. From the four precision-ground bolts the loads are diffused around the circumference in a section of aircraft-type construction. There is a 6in peripheral step between the 9ft-diameter propulsion bay into the 10ft-diameter tank.

The complete tank is fabricated from Firth-Vickers FSM.1 stainless-steel sheet, with thicknesses varying from 0.019in to 0.035in. The two tanks form a monocoque cylinder 10ft in diameter and 46ft in length, designed largely by the lateral loads. The latter arise from motor vibration and thrust-axis variation, wind gust loads before and after launch, and, to a small degree, aeroelastic flexure. To position the c.g. of the fully loaded vehicle as far forward as possible, it was decided to place the Lox tank above the K tank, the respective specific gravities being about 1.1 and 0.78.

Material for the tanks is received as close-tolerance sheet about 36in wide, lengths of which are cut off with diagonal ends, wrapped round and joined by Argonarc butt-welding backed by a spot-welded strap to form a complete tank section. Adjacent sections are then seam- and spot-welded along a lap joint to form the complete tank, extreme accuracy being ensured by extensive jigging. A 0.025in-thick dome diaphragm separates the two tanks; anti-slosh baffles run longitudinally down part of the inner walls of the Lox tank, and three baffle rings, one with an anti-quake truss, are attached inside the K tank. The latter is further stiffened by spot-welding longitudinal top-hat stringers around its outer circumference. This makes it sufficiently rigid to support the weight of the filled Lox tank and upper stages in the event of failure of K-tank pressurization. At all times the K-tank pressure is lower than that in the Lox tank, to ensure that the inter-tank diaphragm is never made to "oil-can" upwards (which would be disastrous).

Any ballistic vehicle, especially a very large one with a light airframe and enormous propellant loads, has to be most carefully analysed from the viewpoint of vibration. These dynamic difficulties are intensified by any increase in vehicle length, and Blue Streak has recently been extensively examined to ascertain that it will behave satisfactorily when the second and hypothetical third stages are added. Primarily the problem is not one of strength, but of having to allow for the effect of all structural deflections upon the control system.

Dominant factors in the dynamics of the control system are determined by the system itself, so its behaviour can be investigated on the ground. The complete vehicle is hung from a rigid tower in a soft suspension of steel hawsers, and, with the loop of the control system closed, vibrations are induced by passing electrical impulses to the engine gimballing actuators. The offset inertia of the engines causes vibrations to ripple up and down the entire structure at the natural frequency of about 0.5c/s, and their character must be investigated for all conditions of tank loading. Computers are necessary to determine the theory of the motion, digital language being used for the bending mode and analogue and digital for final incorporation into a complete system solution.

Eventually it is possible to position all instrumentation—such as rate-gyros—in such a manner that it picks up a minimum of extraneous movement, and nothing that is not allowed for. Wind gust loads and propellant sloshing are all taken into account. As already noted, one tangible result of these investigations is the anti-quake truss forming a slightly asymmetrical "Star of David" across the centre of the K tank. This maintains a basically circular cross-section even under heavy bending loads.

When the tank is complete it is transferred to a handling frame, in which it stays until the complete vehicle is standing vertically on its launcher. The frame, visible in the heading picture opposite, has a gaseous-nitrogen (GN) system which pressurizes the Lox tank at 3.5lb/sq in, while a mechanical system imposes a tensile load of 16,000lb.

[*Continued on page 223*]

A First stage
A1 Main Lox to pump
A2 Lox-isolating valve
A3 Actuator for A2
A4 Main K to pump
A5 K-isolating valve
A6 Actuator for A5
A7 Lox pump
A8 K pump
A9 Water pipes (fire-prevention)
A10 Engine solenoid bank
A11 Turbines
A12 Gas generator
A13 K inlet manifold
A14 Main K valve
A15 Main K feed-pipe
A16 Main Lox feed-pipe
A17 Turbopump exhaust
A18 Lox to gas generator
A19 K to gas generator
A20 LN bottle
A21 LN to "A" heat exchanger
A22 "A" turbopump heat exchanger (LN)
A23 K from start tank
A24 Flexible seal
A25 "B" turbopump heat exchanger
A26 Hot gaseous oxygen to Lox tank
A27 K tank
A28 Lox tank
A29 GN bottles (6)
A30 Lube-oil tank
A31 Chamber actuator (pitch)
A32 Chamber actuator (yaw)
A33 Motor beams
A34 Bridge-type cross truss
A35 Launcher anchorage
A36 Light-alloy propulsion bay
A37 Hinged pannier covers over equipment
A38 Telemetry switch unit
A39 Junction box
A40 Engine safety cut-out
A41 Probe coupling
A42 K filler coupling
A43 WREBUS destruct charges
A44 Turbopump exhausts hinge outwards
A45 Actuators for A44
A46 "A" thrust chamber
A47 Top-hat stringers
A48 Welded brackets
A49 Rings bolted to A48
A50 Anti-quake truss
A51 Gyro mountings
A52 WREBUS boxes
A53 Anti-swirl baffles

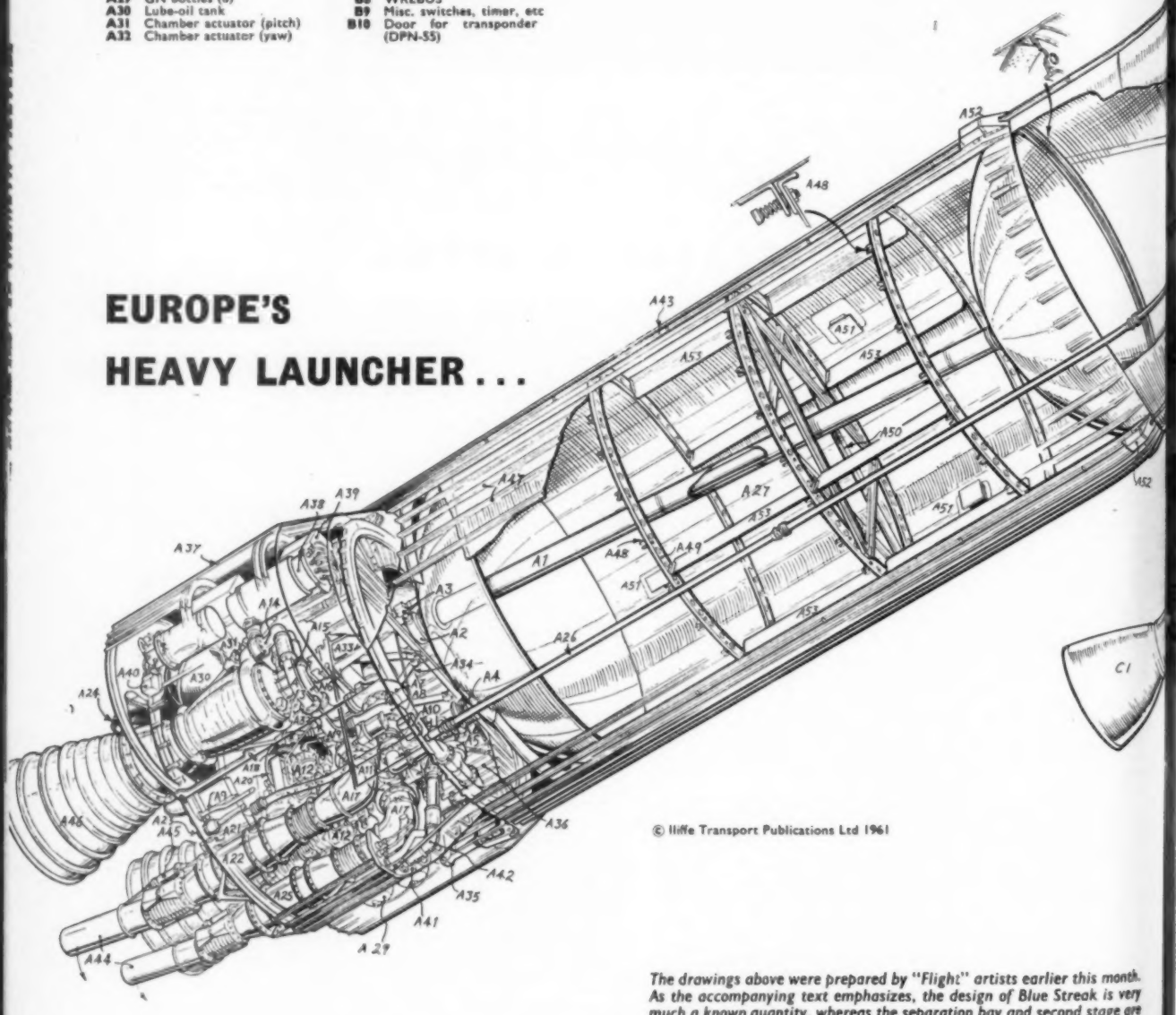
B Separation bay
B1 Holes for second-stage efflux
B2 Welded external stringers
B3 Blast deflector
B4 Battery
B5 Power unit
B6 Transceiver
B7 Telemetry (Type 465)
B8 WREBUS
B9 Misc. switches, timer, etc
B10 Door for transponder (DPN-55)
B11 McGeoch plugs for umbilical supplies
B12 Maintenance platform
B13 Eight explosive bolts
B14 Eight locating dowels

C Second stage (French)
C1 Thrust chamber
C2 Gimbal hinges
C3 Pitch and yaw jacks
C4 Tubular engine mounting
C5 UDMH tank
C6 UDMH filler coupling
C7 N_2O_4 tank
C8 N_2O_4 filler coupling
C9 Equipment bay
C10 Autopilot
C11 Telemetry
C12 Localizer beacon
C13 Safety unit
C14 Battery
C15 Tank pressurization pipe
C16 Aerial (it is not possible to give details of the types of aerial fitted to the upper stages, although the drawing on page 35 of our July 13 issue is relevant)
C17 Aerial
C18 Aerial
C19 Internal stringers

D Third stage (study)
D1 Four thrust chambers inclined outwards
D2 Probably radial gimbal axis
D3 Turbopump group
D4 Heat shroud
D5 Four explosive bolts
D6 HTP tank
D7 K tank
D8 Gas bottles
D9 Pressurized equipment bay
D10 Aerial
D11 Aerial
D12 Aerial

E Satellite (study)
E1 Separation ring
E2 Four skin petals
E3 Petal hinges
E4 Explosive latch and springs
E5 Base housing [illegible] telemetry, [illegible] chemical batteries
E6 Six star-lock [illegible] attitude measurement
E7 Stabilized platform
E8 Bearing housing
E9 Four reaction jets pitch/yaw
E10 Four reaction jets
E11 Propane tank [illegible] jets
E12 Reflecting telescope
E13 Spectroscope
E14 TV camera
E15 X-ray detector
E16 Two solar paddles
E17 Solar paddle [illegible]
E18 Aerials
E19 Aerials

EUROPE'S HEAVY LAUNCHER . . .



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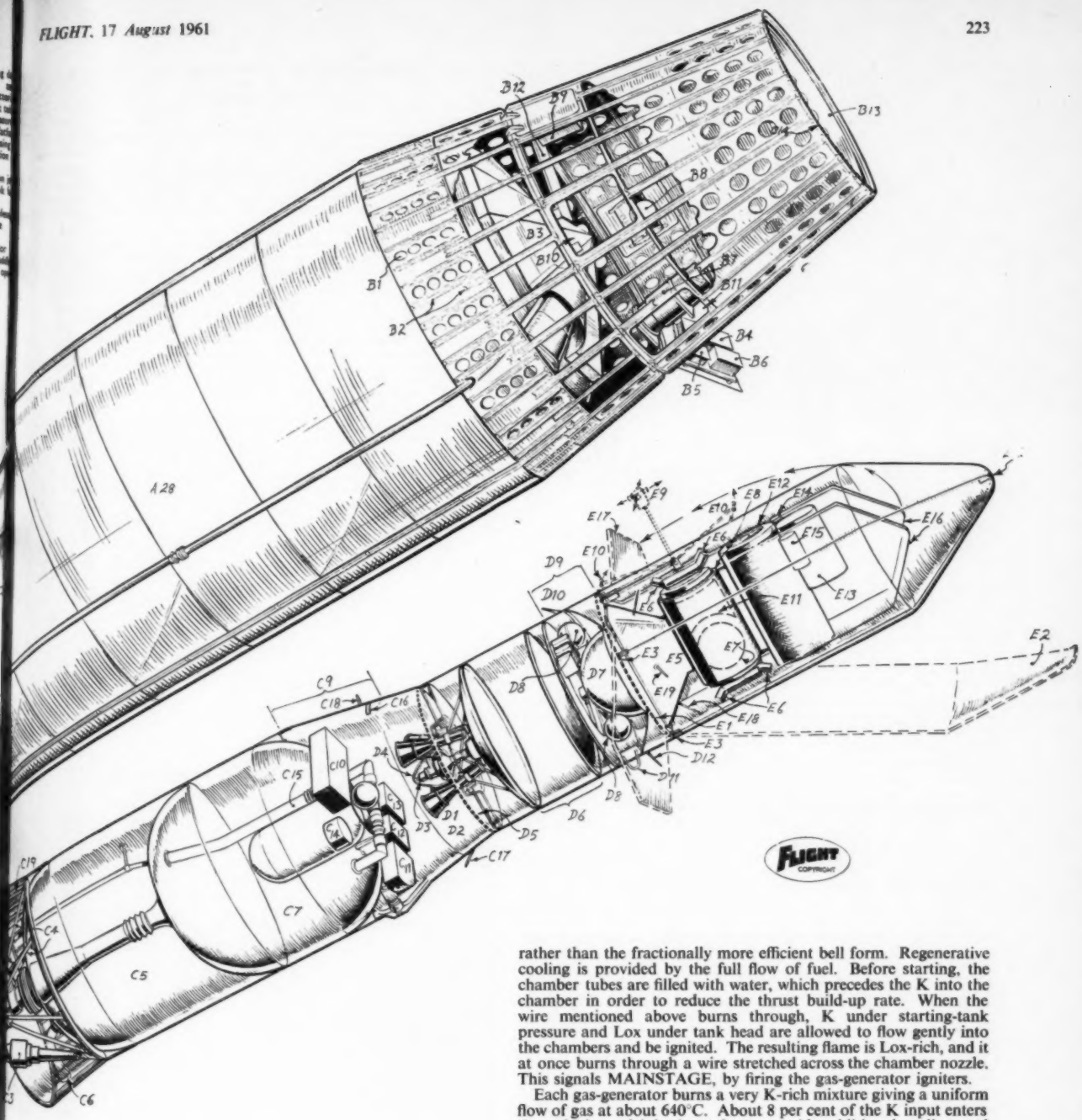
The drawings above were prepared by "Flight" artists earlier this month. As the accompanying text emphasizes, the design of Blue Streak is very much a known quantity, whereas the separation bay and second stage are still subject to variation and the third stage is not yet even designed. The payload illustrated is an astronomical satellite projected by the RAE



Propulsion

Blue Streak is powered by two Rolls-Royce RZ.2 rocket engines, the complete installation being designated RZ.12. Each engine is completely self-contained, with its own gas-generator and turbo-pump. Engine operation is controlled electro-pneumatically, GN being used to actuate all valves as described in the "Systems" section which follows. Engine-starting takes place according to an automatic ladder-type sequence, the successful completion of each step allowing the next step to take place.

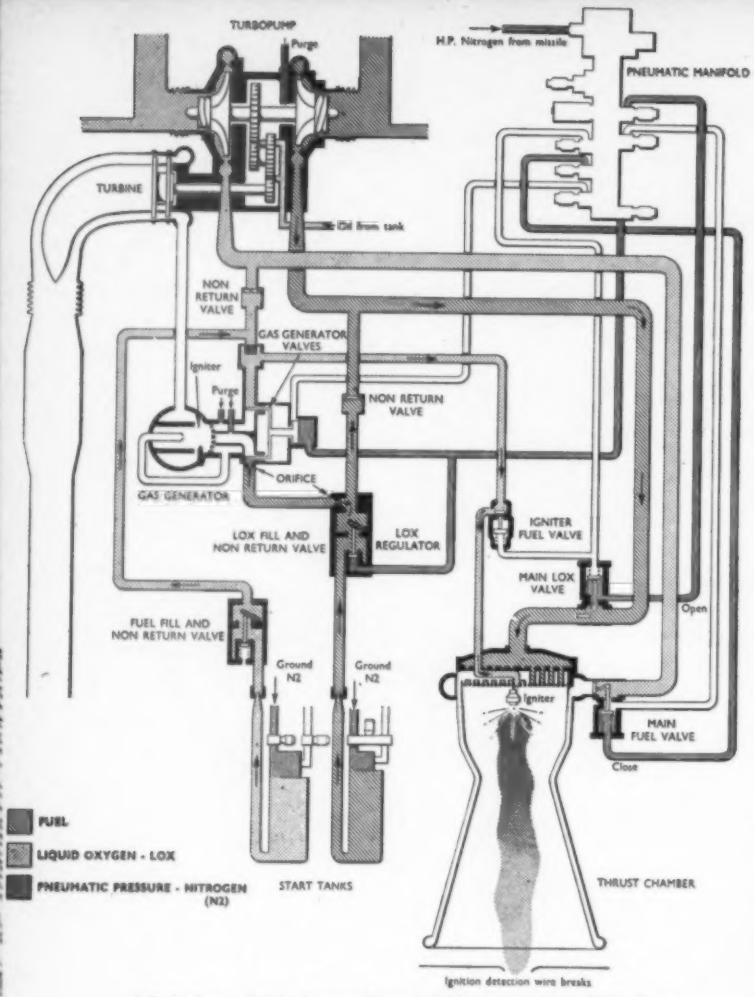
Propellants are liquid oxygen and kerosine to DEngRD.2495, a domestic fuel of high calorific value. Lox and K for starting are supplied from ground tanks, which, together with the lube-oil tank for the gearboxes, are pressurized at the beginning of the START sequence. Firing of the pyrotechnic igniters in the two thrust chambers is then initiated, and the burning-through of an electrical link in each igniter allows the main Lox and K-igniter valves to be opened.

Thrust-chamber construction follows traditional Rocketdyne brazed-tube principles, the divergent nozzle being a simple cone, rather than the fractionally more efficient bell form. Regenerative cooling is provided by the full flow of fuel. Before starting, the chamber tubes are filled with water, which precedes the K into the chamber in order to reduce the thrust build-up rate. When the wire mentioned above burns through, K under starting-tank pressure and Lox under tank head are allowed to flow gently into the chambers and be ignited. The resulting flame is Lox-rich, and it at once burns through a wire stretched across the chamber nozzle. This signals MAINSTAGE, by firing the gas-generator igniters.

Each gas-generator burns a very K-rich mixture giving a uniform flow of gas at about 640°C. About 8 per cent of the K input enters through the end injection tube to provide additional cooling, and the inner chamber assists mixing. Fine control is exercised on the Lox input. Fuel and Lox enter the gas-generator after ignition of the igniters has been proved by burning through a link which signals the main K valves to open. This in turn triggers the gas-generator blade valve, allowing propellant to flow to the gas generator from the start tanks. The gas then drives the turbopump.

This fine piece of machinery borrows much from gas-turbine practice. The two turbine wheels comprise 12 per cent Cr-Niobium ferritic discs carrying fir-tree blades forged in N.80, the whole being overhung from a ball and roller bearing. Labyrinth and carbon seals are used, the latter being a segmented ring adjacent to the roller bearing. A two-stage spur-reduction gear drives the pump shaft, carried in ball and roller bearings, the roller bearing close to the Lox pump being heated prior to starting to prevent the oil from freezing. Both Lox and K impellers are fully shrouded sand-castings, with light-alloy inducers, and the complete turbopump is housed in light-alloy casings lightly pressurized by GN to 5lb/sq in in flight.

Delivery of high-pressure Lox and K to the chambers causes thrust to build up very rapidly. When turbopump delivery pressure exceeds starting-tank pressure the fill/check valves on the starting



A Rolls-Royce circuit diagram for one of Blue Streak's two RZ.2 engines. Engine operation is discussed below and on the previous page

PROBABLE EUROPEAN SATELLITE LAUNCHER

COMPLETE VEHICLE: three stages having overall height of 99ft 5.3in and liftoff weight of 230,769lb.

THIRD STAGE: not yet designed. Estimated overall height, 20ft 8in; diameter, 54in; gross weight, with payload of 200lb, 5,040lb (vehicle, 500; fairings, 40; propellants, 4,300; all-burnt, 700); speed at burnout or cutoff, 17,000 to 24,000 m.p.h., depending on mission; altitude at burnout or cutoff, orbit height.

SECOND STAGE: French rocket to a design nearing completion. Single gimballed thrust-chamber operating on N_2O_4 and UDMH, with thrust of about 68,000lb in vacuum conditions. Overall stage length, 21ft 6in; body diameter, 71in; gross weight, without third stage, 18,150lb (propellants, 15,432; all-burnt, 2,718); estimated burning time, 61sec; speed at burnout or cutoff, 14,500 m.p.h.; altitude at burnout or cutoff, about 105 miles; the spent stage would impact approximately 3,000 miles downrange.

FIRST STAGE: British rocket of known design. Twin gimballed thrust-chambers operating on Lox and K, with performance given hereunder.

Vehicle dimensions: overall length including engines, with current separation bay, 61ft 6.3in; basic length of tank bay, at room temp., 46ft; tank diameter, 120in; length of propulsion bay, excluding engines, 75in; propulsion-bay diameter, 108in.

Vehicle weights: as first-stage of three-stage vehicle, liftoff weight, 207,579lb; as single stage with guidance bay and simulated payload, 210,560lb; all-burnt weight, 13,687lb; propellants, 193,892lb.

Propulsion: present thrust per engine, 137,000lb at liftoff, rising to 168,000lb at cutoff after 160sec at about 250,000ft; uprated thrust per engine, 150,000lb at liftoff. Mixture ratio, by weight of Lox/K, in the range 2.2 to 2.5; specific impulse, 245 at liftoff rising to 285 at cutoff; complete weight of each engine, 1,500lb; chamber construction, 312 nickel tubes with wall thickness of 0.012in; area ratio combustion zone/throat, 1.8:1; expansion ratio of nozzle, 8:1; combustion temperature, 3,190°C; chamber pressure in combustion zone, 544lb/sq in abs; chamber wall temperature, about 400°C in combustion zone rising to 470°C at throat.

Engine gimballing: limits of thrust-chamber movement, anywhere within pyramid of 14° included angle; max programmed turnover rate, 0.7°/sec; hydraulic system pressure, 3,000lb/sq in.

Lox system: tank capacity, 2,000 cu ft usable (12,000 Imp gal or 60.8 long tons); tank pressurization, 5lb/sq in empty, 26lb/sq in full; pressurization by oxygen gas from B heat exchanger.

K system: tank capacity, 1,250 cu ft usable (7,700 Imp gal or 26.3 long tons); tank pressurization, 2.5lb/sq in empty, 11.75lb/sq in full; pressurization by GN from A heat exchanger.

Gas generator: working-fluid mixture strength, Lox/K, 0.351:1; mass flow rate, 2.6lb/sec Lox and 7.4lb/sec K; delivery temperature to turbine, 650°C, 425lb/sq in.

Turbopump: turbine speed, at present engine rating, 29,400 r.p.m.; output, 2,470 to 2,500 s.h.p.; gearbox reduction ratio, 4.88:1; pump shaft speed, 5,987 r.p.m. at present engine rating; Lox impeller diameter, 11in; Lox-pump delivery, 385lb/sec at 787lb/sq in; K impeller diameter, 12.75in; K-pump delivery, 178lb/sec at 750lb/sq in.

Ancillary systems: LN sphere, 145lb capacity; LN pressure to heat exchanger, 120lb/sq in; GN spheres, each 1,037cu in; charge pressure, 3,000lb/sq in; min working pressure, 1,000lb/sq in; Lox pressurization circuit bleeds Lox at about 700lb/sq in at 2·5lb/sec and delivers gas at 180°C at 60-70lb/sq in; lube-oil, 20 gal delivered at 750lb/sq in at 6gal/min total.

EUROPE'S HEAVY LAUNCHER . . .

tanks are closed and the tanks vented. The RZ.12 system is then self-sustaining, and full liftoff thrust is reached approximately 4sec from the initiation of the start sequence.

Complete shutdown occurs automatically should any of a number of operating parameters, such as Lox-pump bearing temperature, go outside specified limits. A predetermined degree of rough combustion also results in shutdown. Programmed shutdown in flight is triggered by the vehicle control system, the gas-generator valve closing some 0.05sec in advance of the main Lox and K valves. The K valve has a longer closing time, and the K-rich cutoff gives more repeatable decay and lower residual impulse.

The RZ.2 thrust chamber is gimballed for vehicle control (both engines together for pitch and yaw, and in opposition for roll), although the high-pressure propellant pipes are connected at their other ends to the fixed turbopumps. Stainless-steel piping is used, and flexible bellows sections accommodate the chamber movement. Each chamber is hung from a cruciform bearing block bolted to the Lox inlet elbow. The bearing is a plain steel surface, and its exact location may be adjusted in order to achieve precise alignment of the thrust axes. Gimballing of each chamber is effected by two hydraulic jacks, one for each axis.

From the turbopumps the fuel-rich gas-generator exhaust is ducted down through a pair of exhaust pipes each incorporating a heat exchanger, discussed in the next (Systems) section. Final discharge takes place through pipes which are pivoted outwards by GN actuators immediately after liftoff, in order to minimize re-circulation of the fuel-rich mixture beneath the vehicle. The exhaust burns away to one side of the motor effluxes, the small lateral thrust thus imparted being allowed for in the control system.

Systems

Lox The balloon tank containing the Lox is pressurized by GN from a ground supply and by oxygen gas in flight. Before launch this pressure is supplied from the ground pneumatic control unit (PCU), which maintains a nominal 5lb/sq in in the tank-empty condition and 26lb/sq in for flight. This pressure is fed through one of the main probe couplings in the base of the vehicle. Lox from ground storage is fed to the vehicle tank through a branch pipe coupled to the main delivery line to the engines. The latter is a 9in-diameter pipe, double-walled through the K tank and down to the main butterfly valve, which is locked open mechanically during flight. Mass flow through this valve is of the order of 21 tons/min. Immediately downstream the pipe bifurcates to feed the two turbopumps.

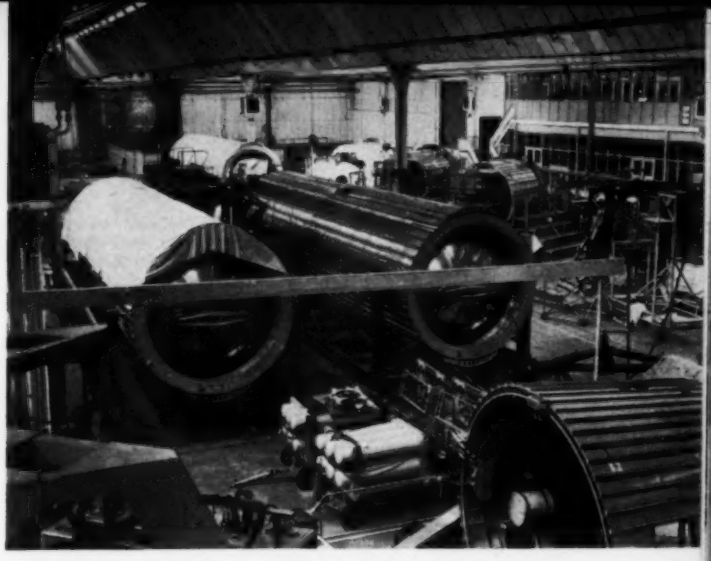
K Pressurized to a nominal 2.5lb/sq in when empty, the fuel tank is charged to 11.75lb/sq in by the PCU before liftoff, pressure thereafter being maintained by the liquid-nitrogen (LN) system. The K leaves through an anti-vortex baffle at the base of the tank, and enters the 7in-diameter stainless-steel delivery pipe. Downstream of the main butterfly valve the pipe splits into two 5in lines to serve the two turbopumps.

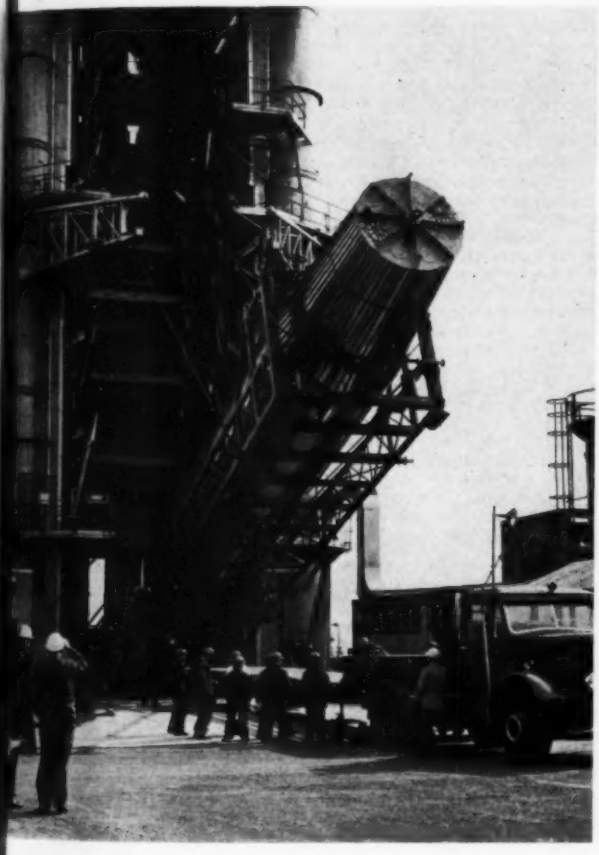
Gaseous oxygen Under flight conditions, the Lox tank is pressurized by Lox, bled off via a control orifice at the rate of about 2.5lb/sec from the gas-generator bootstrap line and converted to gaseous oxygen in a heat exchanger in the exhaust from "B" turbopump. From this multi-tube cross-flow unit the gas emerges at about 180°C, and is fed up along a 3in pipe, fabricated in 0.010in stainless steel, with an expansion bellows every 10ft, to the top of the Lox tank. Two high-pressure relief valves and one low-pressure relief valve are fitted on the top dome of the tank, holding internal pressure to about 5lb/sq in during fuelling. Prior to liftoff, of course, pressurization is provided by the ground PCU.

LN Following disconnection of the PCU shortly before liftoff, pressure in the K tank is maintained by nitrogen gas obtained from a liquid-nitrogen system. The fluid is stored in a single spherical tank in the propulsion bay, with an inner shell of stainless steel some 22in in diameter jacketed by a 23.5in-diameter glass-fibre outer shell, the boil-off gas being vented to the inter-layer space. The LN is expelled by GN at 120lb/sq in, and is piped as a fluid through a control orifice to the heat exchanger in the "A" turbo-

pump exhaust stack. This heat exchanger is a cross-flow unit with 454 tubes arranged as a matrix carrying the hot gas, the LN being passed to and fro four times before escaping in gaseous form. The GN then passes along a 2in line to the K tank.

GN Gaseous nitrogen is the basic working medium for the various vehicle services, propellant valves and pressurization and purging functions. Before launch GN is supplied from the PCU through the main probe connections, at a pressure of 3,000lb/sq in. During the starting sequence the supply is switched to the airborne store housed in six stainless-steel spheres arranged in two rows of three strapped against circular rubber seatings in the propulsion bay. In flight, the GN provides the following chief services: a constant small bleed on the manifold regulator; purging of the Lox-pump seal; expulsion of the lube-oil; gearbox pressurization; and operation of the gas-generator blade valves, Lox and K main valves and de Havilland valve systems. Working pressure of the bottles is 3,000 down to a minimum of 1,000lb/sq in, and the main de Havilland and Rolls-Royce solenoid banks maintain a constant delivery pressure of 750lb/sq in under all conditions.





Electrics Three main systems operate at 115V, 2.4kc/s; 115V, 400c/s; and 28V d.c., the latter controlling the main solenoid banks. All power generated on board is supplied by batteries and inverters. The original missile had an HTP-driven APU.

Hydraulics Engine gimballing is accomplished by a 3,000lb/sq in system using DEngRD.2487 (EEL.3) fluid. The system is energized by a Dowty Vardel pump mounted on each turbopump gearbox, and linear actuation jacks are employed.

Lube-oil MIL-L-6086B Grade L is stored in a 20gal Bristol welded-steel sphere in the propulsion bay, at a pressure of 750lb/sq in. GN pressure feeds the oil at about 3gal/min to each of the two turbopump gearboxes. A total-loss system is adopted, the scavenge oil being discharged overboard.

Although it is well known that the scientific backbone of Blue Streak stems from Farnborough, it may surprise many Londoners to know that the bulk of the design effort has been carried out in the heart of their city. The design has been centred at Conquest House, Theobalds Road, WC1, and at Welkin House, Charterhouse Square, in the City. The former Propeller Company's Hatfield Test Site includes a "battleship-tank" rig for flow testing, a stand holding a complete vehicle for all static tests apart from thrust-chamber firing, and a very rigid stand in which complete vehicles can be subjected to vibration testing and compatibility trials with the launcher.

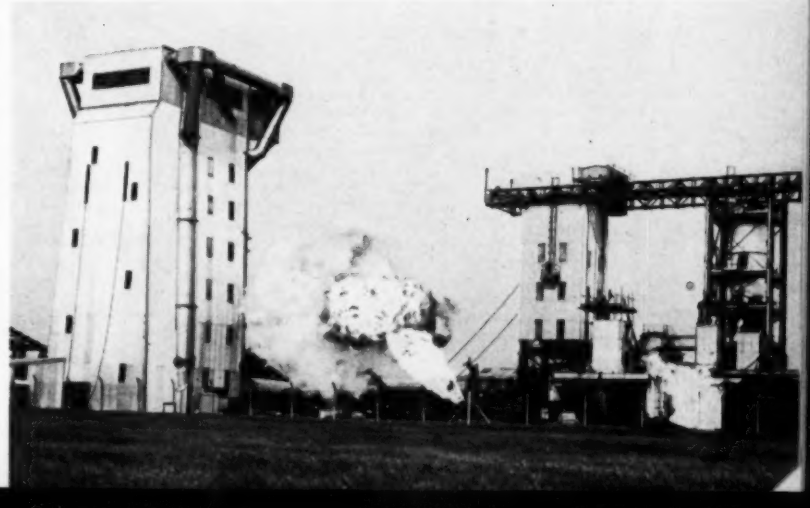
Autopilot and control-system design were handled by the former Propeller Company, the electronic work being based at Hatfield and Stevenage. Airframes are manufactured by D.H. Aircraft at Hatfield, and the complete vehicle is assembled at Stevenage. D.H. Aircraft also make most of the specialized valves, some detail parts coming from the Northern Group of factories in the Bolton area. Component testing and electronic manufacture are centred at Stevenage, but gas-generator and turbopump testing is done at Hatfield.

Most of Rolls-Royce's design and manufacturing effort has been carried out at Derby. All the earliest research, and the first engine static firing, were handled by the RPE, Westcott, but for complete engine and vehicle static trials the Ministry of Supply (now MoA) has built the Rocket Propulsion Establishment at Spadeadam, near Carlisle, which is managed by Rolls-Royce on their behalf. This great £22m facility, which was fully described in our issue dated September 16 last, includes a Lox plant by British Oxygen Gases with an output of 50 tons of Lox and 60 tons of GN per day. There

Stevenage (top right) is the centre for Blue Streak assembly. Tank sections and propulsion bays for a number of vehicles can be seen before and after joining

Spadeadam (above) is a huge Ministry of Aviation establishment for the static testing of complete Blue Streak vehicles. The photograph shows a Blue Streak, pressurized and stretched in its handling frame, being elevated in Stand A1; the handling frame is lowered and removed before firing. It may be seen that the externally stiffened bay above the tank of this vehicle is that of the original missile

Hatfield (right) is the location of the prime contractor's principal test site. The propellant and pressurization towers are visible on the right, the launcher and airframe structural tower on the left, and in the foreground is a fuel-rich exhaust from the static testing of a gas generator



are four engine stands for single RZ.2 or twin RZ.12 hot running, supported by very extensive propellant-storage, cooling-water purification plants, instrumentation and control installations.

These engine stands are numbered A1 to A4, and stand A1 has been modified to accept a complete vehicle, full static testing of a complete Blue Streak having been first accomplished in this stand in May of this year. In another site at Spadeadam are two stands incorporating complete rocket-vehicle test facilities, and one of these (designated C3) is now virtually complete. Stand C3 includes a servicing tower running on a railed causeway and a water-cooled deflector bucket designed for full 180sec mainstage tests. There are no plans actually to launch a vehicle here.

At Lake Hart, South Australia, the Weapons Research Establishment has an almost completed Blue Streak launch facility. It is virtually a facsimile of Spadeadam stand C3, apart from the fact that the launcher (described in our issue dated March 11, 1960) can be rotated in azimuth and that, as it is located on the side of a sheer cliff, no deflector bucket is necessary. The Lake Hart site includes a Lox factory and full supporting facilities.

UPPER STAGES

It cannot be too strongly emphasized that as soon as one turns one's attention to anything higher than the top of the Blue Streak Lox tank one enters regions of uncertainty. As already stated, the separation bay between the first and second stages is by no means a firm design, and even the French second stage cannot yet be freely discussed in detail. As for the third stage, this is at best only a rough study which is currently being used as a basis for discussion and the calculation of likely overall performance. Apart from the declaration at Strasbourg that the third stage will be "the responsibility of a country or countries other than the United Kingdom and France," it is not even known where it will be designed.

Separation bay

Principally the responsibility of de Havilland Aircraft, this large section mates the first stage to the second, bears all loads arising from the upper stages and provides an unpressurized volume for a considerable amount of equipment required up to the point of inter-stage separation. The structure is a stainless-steel monocoque, stiffened by external top-hat stringers. The skin between the stringers may be extensively cut away by large holes through which the second-stage propulsion can exhaust during the period of separation. The skin is only lightly loaded, being required chiefly to react shear due to motion about the roll axis. Although the bay tapers appreciably, kinetic heating is not expected to be a major problem. The most severe heating is experienced only about two-thirds of the way through the period of first-stage powered flight, about 90 to 100sec from liftoff when the vehicle is well above the tropopause.

Above the Blue Streak Lox tank are the oxygen pressurizing pipe and tank relief valves, and superimposed is a blast shield terminating in a point immediately beneath the second-stage engine. Around the sides of the bay are six large doors, on five of which is mounted equipment. One door hinges upwards, and carries the telemetry group; the other five hinge downwards, and respectively carry an electrical group, a transponder, an umbilical connector, the WREBUS equipment and a miscellaneous switch and timer group. The WREBUS gear was first indicated in the drawing of the three-stage vehicle published in our issue dated July 13; its function may not be divulged, but the author considers that "Weapons Research Establishment break-up system" is the obvious interpretation. If this is the case, the WREBUS aerials pass command signals which trigger the explosive charges and cords mounted along the Blue Streak tank sections. Their purpose is evidently to blow up the whole first stage to prevent it from falling intact—possibly nearly full of propellants—following a malfunction in flight. Sundry additional aerials are mounted on the separation bay, and it may be seen that no blast holes are cut in the skin above the six doors.

Second stage

First precise design details of this vehicle were given exclusively in *Flight* for February 17 last. The Ministry of Aviation has said that it "will make use of techniques currently under development" in France, and one of these techniques is certainly film-cooling of the interior of the thrust chamber by fuel, as is done in the latest version of the Véronique sounding rocket. The single chamber is attached to a universal-joint anchorage mounted on six tubular struts, and is gimballed by two hydraulic actuators mounted at 90°. Propellants are the high-energy hypergolic (self-igniting) mixture of N_2O_4 (nitrogen tetroxide) and UDMH (unsymmetrical di-methyl hydrazine), the same combination as is employed in Titan 2.

Tankage is spun and fabricated from sheets of Vasajet 90, a vanadium-steel of great strength and resistance to corrosion. Tank diameter is 71in, and the oxidant tank is separated from the fuel by a convex domed bulkhead. Both tanks are filled through adapters on opposite sides of the skirt section, and the propellants are fed down to the engine by pressurizing the tanks. An inert-gas flow at the desired pressure is provided from a solid-fuel gas generator, and additional pipes from this unit feed roll-control jets located outboard at the top of the stage. The skirt section around the base of the fuel tank is 25in high and is stiffened by internal stringers and rings. It mates with the top of the de Havilland separation bay, the joint being made by eight explosive bolts with a locating dowel adjacent to each.

Details of the equipment and systems may not yet be divulged, but preliminary information suggests that a considerable amount is carried. Our drawing shows the various major items located in the unpressurized equipment compartment above the oxidant tank, and rate gyros for the autopilot are also carried in a different location.

Facilities for the manufacture and testing of the second stage either already exist or are being provided as part of the French national programme. Static testing of the proposed propulsion system can already be handled by the Laboratoire de Recherches Balistiques et Aérodynamiques, at Vernon (Eure), and the facilities at this establishment are being considerably expanded. Special production facilities exist or are being built in the Paris area, the Etablissement Aéronautique at Toulouse is equipped for structural testing (including kinetic heating), an environmental laboratory has been set up at Cannes and facilities will soon exist at Colomb-Bechar, Sahara, for flight trials of the complete second stage. The rate of development of this well-known range is compatible with the proposals which have been made.

Third stage

Although our artist's sketch may appear convincing, it is little more than a pipe-dream, inserted partly to avoid having a disconcerting empty space but principally because the design illustrated is actually one which is currently being used for theoretical discussions. The propellants are HTP and K, and it may well be that the proposed European Launcher Development Organization will decide that this combination should be rejected in favour of Lox/hydrogen or another high-energy mixture. Such a decision would certainly increase the development effort required to produce a reliable third stage, but the increase in performance would be considerable.

It is permissible to state that the four thrust chambers depicted are based on an existing design—not a publicized one—and it can be seen that they are spaced equidistantly around a single turbopump rotating about a vertical axis. This turbopump, and its associated equipment, are protected by a large heat shield, through which the four chambers project. Above the HTP tank can be seen a pressurized equipment bay containing the small K tank, two nitrogen bottles for propellant expulsion, and several electronic trays sliding out for access along chordal lines rather than radially. The usual aerials are provided, and the complete stage is mated to the second by four explosive bolts.

Payload

The European Launcher Development Organization, which does not yet even exist, will be the body which will decide what the payloads will be, and in what order they will be fired. Our artist has indicated an RAE satellite which was revealed at the recent Open Day and first illustrated in our issue dated June 22. This particular study seems to have been the subject of a considerable amount of thought, and is worthy of description.

An astronomical satellite, it is initially enclosed in a fairing consisting of four panels arranged to petal outwards and detach themselves following cutoff or burnout of third-stage propulsion. The base of the satellite, to which the fairings are initially hinged, also carries two large solar panels which hinge outwards to provide a charge current to the chemical batteries located in the base compartment. Also inside this compartment is telemetry equipment, data storage, a command link and mountings for the satellite aerials.

Above is a stable platform and control equipment providing a reference fixed in space. At each end are three star-tracking telescopes, and the platform attitude is controlled by a system of small jets fed with propane from a tank on the centreline. Three arms, each some 50in long, are hinged at one end of the unit, the central arm bearing a canister with two jets for pitch and two for yaw, while the other two arms each carry a pair of jets for roll control. Above the stable platform are mounted a reflecting telescope, with controllable mirrors and a camera-type iris, and above again are mounted a spectroscope, TV camera and X-ray detector.

Such a payload could be placed in a 300-mile polar orbit by the three-stage launcher which has been described. Alternatively, the Ministry of Aviation have suggested:

"A smaller satellite weighing several hundred pounds in an eccentric orbit going out to two or three Earth radii, for the investigation of the Earth's gravitational, magnetic and radiation fields, and the constitution of the Earth's outer atmosphere.

"A small satellite of about 100lb weight, reaching out to about 100,000 miles in a highly eccentric orbit to study the Sun's atmosphere."

AMERICA AIMS AT THE MOON

By a correspondent

Washington, DC

THE United States space programme, subject to much criticism during Mr Eisenhower's later years in office, is fast taking form as the brightest spot in the record of the Kennedy Administration. Mr Kennedy, whose campaign against the Republicans last year was based in part on US failures in the space race, seems bent on making certain that, whoever his opponent may be in 1964, he will have no opportunity to use the criticism of slowness in space against the Democrats.

There can be no doubting the general feeling in the United States that the Kennedy Administration is making real progress in space, even though it has been in office only seven months. Several things have occurred in that short time to put the US space programme in a better light.

First, of course, have been the two successful manned ballistic flights, marred only by the loss of the second Mercury capsule during recovery operations. No one in America compares these flights to those of Maj Gagarin and Maj Titov, but their success is felt to augur well for spaceflight progress in the US soon.

Second, conspicuous shortcomings in other endeavours undertaken by the Kennedy Administration, as well as the worsening international situation, have polarized criticism around things other than the space programme. The failure of the Cuban invasion, planned during the Eisenhower Administration but carried out by the present Administration, has absorbed the attention of most professional critics. The slowness of US economic recovery, with unemployment still running at twice its "acceptable" level, has concentrated much attention on the nation's economy.

Premier Krushchev's demand for a settlement of the Berlin question on his terms, and the Administration's announced intention of maintaining itself in West Berlin, have eclipsed all but manned space launchings on the country's television tubes and the front pages of newspapers. Against this backdrop of mounting problems and failures in other areas, the US space programme shows up as one of the Kennedy Administration's best efforts. The Administration is capitalizing on this fact all it can.

In Congress, where telling criticism was voiced against the Eisenhower space programme from the time Sputnik 1 went up, there now is almost no criticism, and a lot of praise for the way the National Aeronautics and Space Administration is doing its job. A year ago the same congressmen were complaining that NASA "lacked a sense of urgency" about getting to the Moon.

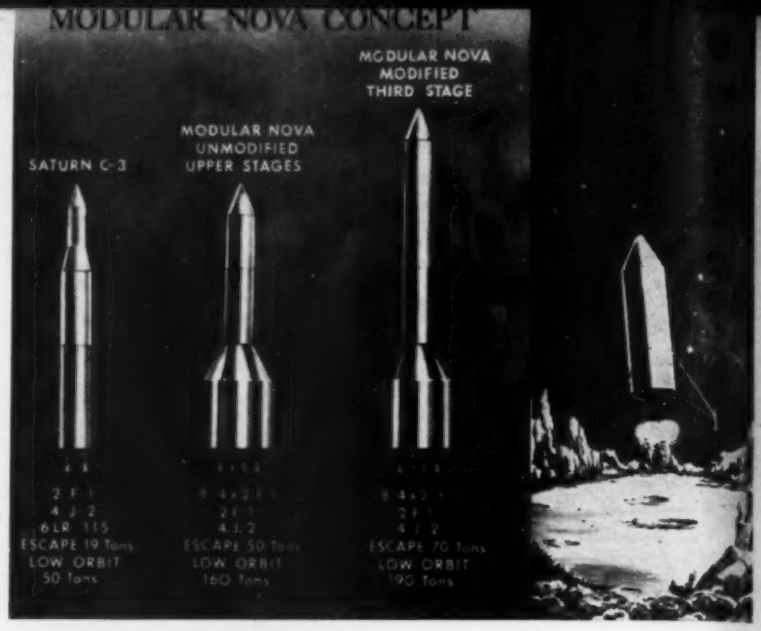
Dr T. Keith Glennan, NASA Administrator during the Eisenhower Administration, took the view that the United States really was not in a space race with the USSR, but instead was pursuing its own space objectives more-or-less without reference to the accomplishments of the Russians. The Kennedy Administration says flatly that the USA is in a race, and that it will have to make an all-out effort, costing billions of dollars, to catch up.

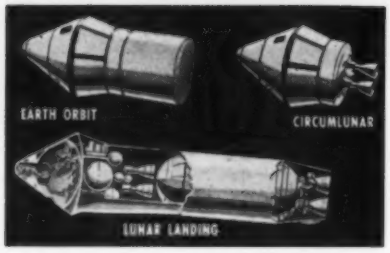
With this, nearly all congressmen agree. They also agree with the Kennedy Administration's choice for NASA Administrator, Mr James E. Webb. Mr Webb does not appear to have a critic on Capitol Hill, whereas Dr Glennan had many before he left office. Mr Webb was the choice of Vice-President Lyndon Johnson and Oklahoma Senator Robert S. Kerr, both of whom have taken a great interest in the US space programme. Mr Johnson, when he was majority leader in the Senate last year, was a frequent critic of the Eisenhower Administration's space programme. Mr Kerr is chairman of the Senate's important Aeronautics and Space Sciences Committee. The three men, who have known each other for many years, work well together.

Mr Webb spends much time on Capitol Hill. He is an old hand with congressmen, and is careful to address each by his preferred title. In the past Mr Webb has been Director of the Bureau of the Budget, where he has many friends who are important to him now. Similarly, he has been an Under-Secretary of State and has many friends in the Department of State. He knows his way around in industry, through past associations with Sperry Gyroscope and

Heading photograph, three-stage Saturn C-1 booster (dummy upper stages), with Mercury-Redstone and Juno 2, at Huntsville. Below, in Washington (from the left) Rep Overton Brooks, NASA Administrator James E. Webb and Mr George M. Low, chief of NASA's manned spaceflight programme, examine a Project Apollo capsule model

AMERICA AIMS AT THE MOON . . .





Above, modular Nova concept, based on clustering Saturn C-3 boosters, which could land three-man spacecraft (above right) on Moon. Left, possible Apollo configurations for three missions. Far left, triple payload launched on June 29 into Earth orbit: from the bottom, Transit 4A, Injun and Greb (see table, pages 232-3)

more recently with oil and other interests in the midwest.

Last year serious consideration was being given in Congress to turning over several of NASA's new-found space projects to the Air Force. Now that Mr Webb is in the chair vacated by Dr Glennan, the Air Force has found it expedient to retreat to previously prepared positions, and most of the country's space research is unquestionably in the hands of the civilian agency.

Best evidence of NASA's new standing in Congress came last month when the space agency's appropriation bill for $1.7 billion was passed by the lawmakers without changing so much as a word or a comma. It was a bi-partisan vote of confidence for Mr Kennedy's programme to put a man on the Moon before the end of the decade. This is the programme the Kennedy Administration is betting on to win the space race. It is recognized that the USA no longer can catch up to the USSR on orbital flights around the Earth, but perhaps by dint of an all-out effort it can beat the Soviets in the newer, vaster phase of the race represented by placing a man on the Moon. Major space concepts take a long time from conception to working hardware, and man-to-the-Moon is the first major space project the Kennedy Administration has been able to direct right from the start. Even so, Mr Kennedy is in effect placing his bets on a project that will not be completed before he must again face the voters in 1964.

Contractors and scientists, and in recent weeks the general public, are coming to realize how much is at stake in the race to the Moon. Trevor Gardner, one-time Under-Secretary of Defense for Research and Development during the Eisenhower Administration, expressed the feeling of many when he told an audience of space engineers in Los Angeles recently: "The President's proposal [to land a man on the Moon before the end of the decade] is a dramatic, necessary and timely reversal of a trend. He now offers us the leadership and the opportunity to erase the familiar phrase 'we are behind' from the blackboard of time." Mr Gardner's comment is echoed throughout the US space science community, where the general feeling is that a full-fledged American space programme at long last is on its way.

Though the President has said that America wants to get to the Moon before the end of the decade, NASA officials now talk about making it no later than 1967—and perhaps in 1966 if "we have just a little luck and no more foul-ups than usual."

Project Mercury, already well down the road and into hardware when Mr Kennedy came to office, will be continued more-or-less as the Eisenhower Administration conceived it, with unmanned orbital flights around the Earth later this year and a manned orbital flight perhaps early next year.

To get to the Moon will require sizeable improvements in the state of the art in rocket propulsion, space communications and operations, and the development of landing and operating techniques for use on the Moon, as well as special knowledge and technology for the return flight.

The lack of large rocket boosters has long been a bugaboo to US space research. NASA's answer to the problem has been to speed development of the F-1 liquid rocket engine, capable of 1.5 million pounds of thrust. Whilst NASA spokesmen and engineers from North American Aviation's Rocketdyne Division, developers of the F-1, said as recently as December that the F-1 would not be ready until 1965, the date now being talked about is 1963. Already the engine has gone through a static firing at Edwards Air Force Base in California and has exceeded expectations.

With F-1 development speeded up, it seems likely that the huge Nova booster vehicle, employing ten F-1 engines and four liquid hydrogen/oxygen engines in various configurations and stages, will be ready to succeed Saturn as the big US space booster earlier than anticipated. In the $1.7 billion voted by Congress in July is $144.5m to begin work on the Nova vehicle, the design of which will get underway soon at the Marshall Space Flight Center at Huntsville, Alabama. Nova will be used to launch the Apollo vehicle that will carry three astronauts to the Moon.

As back-up for the F-1, the US Air Force has been authorized to study the feasibility of large solid-propellant boosters that could substitute for the F-1 in case the latter does not come up to expectations. Quite likely solid boosters of 1.5 million pounds or larger will be developed in any event because they lend themselves to specific military applications.

Another propulsion contract, also important to NASA's long-range space programme, was let in June. This was for NERVA, a project to develop a nuclear rocket for use as an upper-stage booster for unspecified space missions. Two companies, Aerojet-General and Westinghouse, will make proposals by the end of the year.

Work is already underway on the capsule to take an American space team to the Moon and bring them back. As Astronaut Virgil Grissom was preparing for his ballistic shot down the Atlantic Missile Range last month, representatives of 900 potential contractors were meeting behind closed doors in Washington to hear details of Project Apollo, which, until lately, has been little more than a gleam in the eyes of NASA scientists.

The timetable presented to the contractors, 300 of whom will win awards before the end of this year, caused a low whistle to run through the space industry. It calls for an all-out effort, with the three-man capsule to be ready for an orbital flight around the

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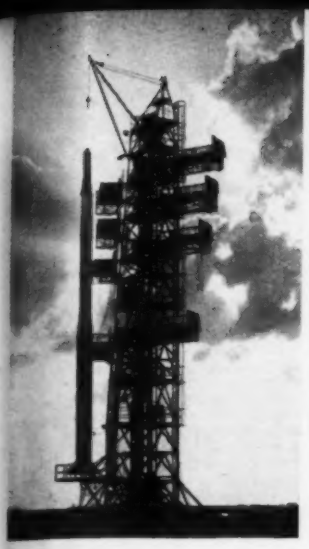
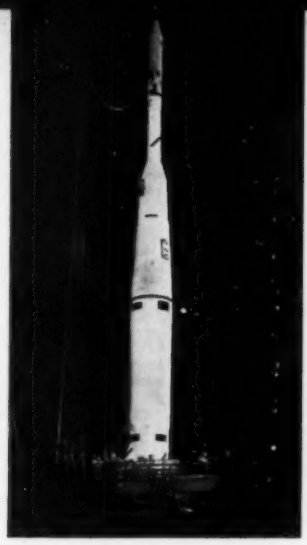
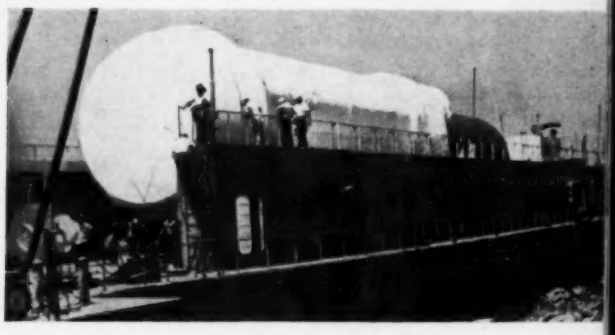






Contrasting launch vehicles in the US space programme: left, four-stage all-solid Scout on the pad at Wallops Island; centre, three-stage Thor-Delta at Cape Canaveral; right, the massive Saturn booster begins its 2,200-mile water journey to Cape Canaveral by special barge from Florence, Alabama, on the Tennessee River, after having been hauled overland around the damaged Wheeler Dam

Earth aboard a Saturn booster late in 1963, and an orbit around the Moon in 1965 at the latest. It is generally agreed that if the first date is met, subsequent flights may be accomplished sooner.

Contracts for the Apollo capsule will run to nearly a billion dollars, and this prospect has stirred US space contractors more than anything since McDonnell Aircraft Corporation won the Mercury capsule contract. By and large, the industry is impressed by the dispatch with which NASA now moves and the way it is biting off space work in big chunks. Space contractors also recognize that the competition among them is going to be keen, and that Apollo may mean "quick death" for a few big firms in the space business. Those who do not win a place on Apollo, or do not make a try for it, may well end up outside the space field for good. This is because Apollo represents a major step forward in the state of the art, and those who are not familiar with what is done on this project will find it hard to catch up.

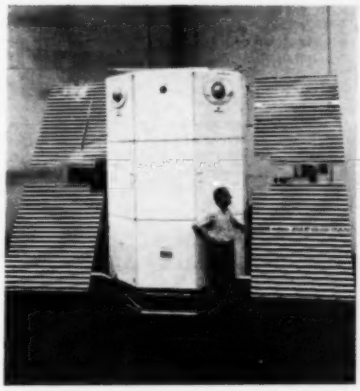
But on the whole they see the picture as encouraging. Increased military spending, together with NASA's enlarged outlays, already are being felt in partially empty aircraft, missile, electronics and engine plants across the country. Recruiting of technical personnel, which dropped off sharply in 1960, shows signs of being renewed on a grand scale. A few contractors are finding their facilities insufficient for the new military and space business they anticipate over the next several months, and are looking around for rental space, or are thinking of putting up more brick and mortar. NASA will construct its own centre for Project Apollo and similar programmes to follow, and several states are vying with one another to have the centre located within their borders. On the New York Stock Exchange, issues even remotely identified with space are booming, and in some instances are selling at 30 to 40 times earnings, without prospect of a cash dividend for years.

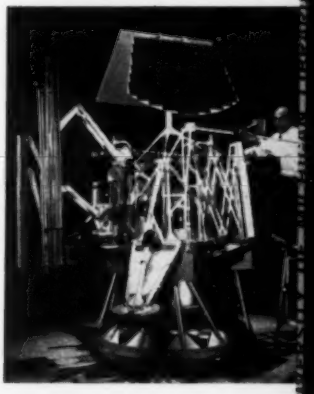
The American space effort, including NASA programmes plus those of the US Air Force and other, lesser agencies, will cost United States taxpayers almost $3 billion in 1962. Spending for space programmes will increase markedly over the next several years, if Congress approves. NASA privately estimates the total cost of the man-on-the-Moon project at $20 billion, and figures as high as $40 billion have circulated from unofficial sources.

This has not bothered the American public, which has yet to hear how it will pay for the space programmes. No new taxes are likely to be passed this year, but next year the prospect is for a general overhaul of the US tax structure and the collection of more money by the government. President Kennedy has put the case for the space race in a positive way, appealing to national pride.

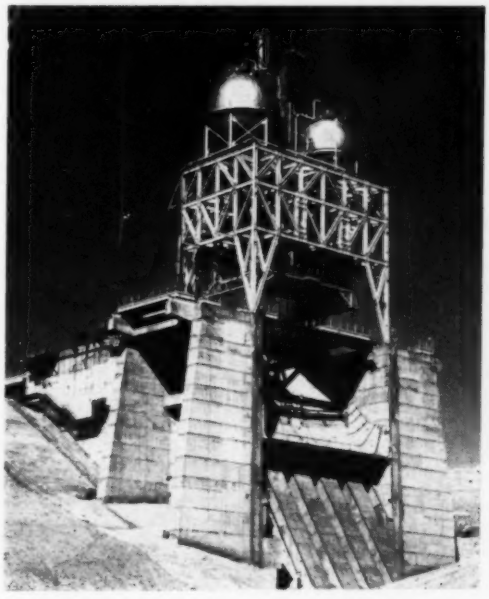
A recent Gallup poll, taken just before the President's announcement, asked a cross-section of American people whether they thought it worthwhile to spend an estimated $225 for every man, woman and child in the United States to send a man to the Moon. Only 33 per cent said "yes," 58 per cent said "no," and 9 per cent had no opinion.

This perhaps proves little, except that the typical American would like to see one of his countrymen be first to take a trip to the Moon, but doesn't like paying for the ticket. Even that may be somewhat of a false premise. When Commander Alan Shepard made his flight in a Mercury capsule, a US news agency put out the story that the cost to each American, on the average, was $2.23. As a result, NASA received letters by the basket enclosing checks for $2.23—so many that it had to set up a special account that now runs to five figures.





Above, space payloads have the strangest shapes. Left, mock-up of NASA/Grumman Orbiting Astronomical Observatory; right, mock-up of NASA/Hughes Surveyor Moon-landing spacecraft. Below, the man at bottom centre gives scale to the huge test stand at Edwards built for the static firing of twin F-1 engines



THE RUSSIAN SPACE ROCKETS

This photograph is taken from "With Gagarin to the Stars," due to be released on September 3. Until we see the film it is difficult to interpret this illustration, but it appears to show the flames from a close group of engines, with small side flames due to turbopump exhausts or verniers

WHAT picture can we form of Russia's big space rockets? There are a number of leads to follow up, but none takes us to either detailed or definite conclusions. Not, at least, on the basis of publicly available knowledge. But in view of the immense hopes which have been aroused—the drastically foreshortened perspective of travel to the Moon and planets—there can be no question of the crucial interest of the subject.

The course which the Russian space programme has taken is clear. It forms a meaningful pattern, with strong indications of distinct stages of rocketry achievement. The Russians have given precise data about the weights of their payloads and the orbits achieved. This provides a basis for comparison with the capabilities of US rockets, and for analysis according to the theory of rocket propulsion.

Again, the aims of Russia's programme in the next few years are not in much doubt. To realize them will require major developments in rocket technology. If the Russians seem confident of success it should imply that they have these developments well in hand.

The best way to pick up the trail is by a review of the Russian programme already accomplished. At the time of writing, this comprises seventeen major events. These events fall into two main phases. Phase I began with the launching of Sputnik 1 on October 4, 1957, and ended with the success of the automatic interplanetary station Lunik 3 in October 1959. Phase II began with tests of a powerful new rocket for space purposes in January 1960, and led to the manned orbital flights of April 12 and August 6, 1961.

BY TONY DEVEREUX

These phases are primarily characterized by the nature of the mission. The missions are in turn related to the capabilities of the available rockets. There is much evidence that the two phases correspond to two basic launching vehicles.

Phase I. Sputnik 1 was launched about six weeks after the Soviet Union announced successful tests of an ICBM in August 1957. Few would doubt that the ICBM was the launcher. The importance of Sputnik 1 was that it provided initial data on satellite behaviour, and experience with telemetry and tracking. That it did not extend the capabilities of the rocket was evident a month later from Sputnik 2.

Sputnik 2, including in its 1,120lb payload the dog Laika, was a significant early pointer to the motives of the Russians. It proved the feasibility of spaceflight for a higher vertebrate—and so, by reasonable inference, for man. Clearly, the Russians planned for manned space travel before even the first Sputnik was launched, and with the information gained from Sputnik 2 they had no more, for the moment, to ask.

Sputnik 3, a satellite dedicated entirely to physical experiments, came 29 weeks later. At 2,900lb it was a surprising witness to the power of the Russian launching vehicle. Had a new launcher already become available? This was not easy to believe, but the question became acute with Lunik 1, 32 weeks later.

Lunik 1 forms a well-defined group with the two subsequent Luniks in 1959. Payloads accelerated to approximately escape velocity were successively 797lb, 858lb and 957lb; weights of the final stage of the carrier rocket with payload, but without propellants, were 3,245lb, 3,324lb and 3,416lb. Taking a closer look at the figures for Lunik 1, we have by deduction about 2,448lb for the rocket structure, which might contain anything up to nine or ten times its own weight of propellants. The total weight of this final stage with payload might therefore range up to 25,000lb. Dimensions of the exhibited replica of Lunik 2's undoubtedly similar final stage are consistent with this figure.

It is a reasonable inference from these figures that the launching vehicle could have placed into close orbit a payload of perhaps 9,000lb. Thus the Luniks testify to a more powerful launching vehicle even than Sputnik 3; yet it was available only 15 months after Sputnik 1 was launched. Was it essentially a new launching vehicle, or were we seeing simply the progressive exploitation of the original ICBM? On this problem fell a new light with the opening of Phase II a few months after Lunik 3.

Phase II. In January 1960 the Russians made two long-range firings into the Pacific. These were stated to be tests of "a powerful new multi-stage rocket for space activities." The following May this rocket was used to orbit the first Soviet spaceship-satellite, of some 10,000lb weight.

At first sight it may seem that this demonstrates only a relatively small advance on the implicit orbital-payload capabilities of the Lunik rocket. But the subsequent course of events, including the orbiting of Sputnik 7 at 14,295lb, provides good reason for accepting that this is a new and bigger rocket, constructed deliberately for space exploration, making its début with a payload which by no means represents its ultimate potential.

Five more launchings of the spaceship-satellite bring us in the short period of eleven months to the orbital flight of Major Yuri Gagarin. It is appropriate at this point to go back and consider the position that existed after the launching of Sputnik 2. The feasibility of manned spaceflight was broadly established. Plans and projects then already under way could be pressed forward. It was necessary not only to create a spaceship, but to have a suitable vehicle ready for it.

In fact, the launching vehicle and its spaceship payload were available at virtually the same time: early 1960, little more than two years after Sputnik 2 gave the green light. Following the first orbiting of the spaceship-satellite, two more experimental firings of the rocket were made (July 1960); then four further spaceship-satellite launches proved the system sufficiently for the manned orbital flight. Two characteristics stand out about this progress: it is very swift, and very economical in means. Both imply well-integrated design of rocket and spaceship on a basis of research and development initiated long in advance.

The least requirement of a launching vehicle specifically created for space exploration in conjunction with a spaceship-satellite would be to place the spaceship into close orbit. More ambitious experiments might well involve accelerating it to near-escape velocity. It seems, for example, that with little adaptation the spaceship might be suitable for a circumlunar mission. This implies a close-orbital payload capability exceeding the actual weight of the spaceship by a factor of perhaps about 4. In orbiting the 14,295lb-payload Sputnik 7 the rocket confirms part of this conjectured reserve of power. The balance of evidence is therefore strong that the rocket annnonced at the beginning of 1960 was a major advance.

In turn, it becomes unlikely that a basically new rocket was previously introduced. The point at which a new rocket might have been introduced is for Lunik 1, on January 2, 1959. But this is little more than a year before, and it is difficult to imagine that a new, bigger rocket would be introduced to be employed only three times and then superseded in a year. Equally, it is difficult to believe that a basically new rocket was introduced only 15 months after the original ICBM had launched Sputnik 1.

We are driven to conclude that the progressive increase in power revealed during Phase I was the development of the original launching vehicle based on an ICBM. It may have been that Russia had two ICBMs under parallel development, one more powerful than the other, comparable with the US Air Force Atlas and Titan. If this was the case, the projects matured much closer in time than the US projects, suggesting a closer technological relationship. This could mean much the same thing as extensive development of the original ICBM.

How big a rocket was this Phase I launching vehicle in its earlier applications?

The length of the carrier rockets which orbited with Sputniks 1 and 3, and the length of Sputnik 2 where the payload was united with the carrier rocket, were the subject of several optical estimates. These seem to range from about 60ft for Sputnik 1's rocket to 80ft for the Sputnik 2 combination. Some reports give Sputnik 3's rocket as about 70ft in length. On the whole this is a consistent picture for the final stage. We also know that Sputnik 3 was about 6ft across the base, and the Lunik final stage about 10ft in diameter.

First conclusions

The provisional conclusion is that, while the Russians may have varied the tankage of the final stages of Sputniks 1, 2 and 3 by varying the length and diameter within certain limits, it is in all cases big enough to suggest the second stage of a two-stage rocket. By appeal to US information, a two-stage rocket built to a scale rather larger than Titan 2 should account for payloads of the order of these three Sputniks. Conventional propellants are assumed, with specific impulse in the Lox/RP-1 class. At launch the rocket might weigh 250,000 to 300,000lb, and develop a thrust of 400,000 to 500,000lb. These figures may be criticized as larger than necessary, at least in respect of the upper limit. But we can be concerned only with orders of magnitude; and we must allow for the certainty that the Sputnik launchings were not marginal achievements, but were comfortably within the capabilities of the rocket.

We cannot rule out other possibilities. But if we accept a two-stage rocket for Sputniks 1, 2 and 3, we are left with the reasonable assumption that it was adapted for the Luniks chiefly by the addition of one more stage. By itself this third stage would not provide all the extra performance; it would be necessary to increase the first-stage thrust. What size and power would the Phase I launching vehicle represent in its final, most developed form?

This problem can be again approached with US information. The performance of the Phase I launching vehicle in its final form compares closely with the performance predicted for the Atlas-Centaur. Figures which have been given for Centaur are: close-orbit payload, 8,500lb; escape payload, 2,500lb (recently revised from 1,500lb). These are presumably theoretical limits, as against the practical figures established by the Luniks; but they suggest that the vehicles have similar capabilities. Maj-Gen Don R. Ostrander, addressing the American Rocket Society on May 10, 1960 (i.e., before Sputnik 4, the first spaceship-satellite), said: "In Centaur, the US has a launch vehicle able to duplicate the payload capability of the Sputnik vehicles" ["has" or "will have"?—Ed].

Centaur is to achieve its performance from the 360,000lb-thrust Atlas by using liquid hydrogen and liquid oxygen for specific impulse of some 420sec in the second stage. Can it give us a useful indication of the size of the Lunik launcher—which we are assuming did not use propellants comparable with liquid hydrogen and liquid oxygen? A rocket relying on conventional propellants would have to be substantially heavier. Let us tentatively suggest first-stage thrust of 600,000 to 700,000lb, and a liftoff weight of 350,000 to 450,000lb.

By comparison with Centaur, much greater first-stage thrust is easier to accept than considerably increased weight. Centaur is reported to have a liftoff weight of about 290,000lb, giving a thrust/weight ratio of about 1.24. The initial acceleration which this implies of 0.24g, compared with the usual optimum of about 0.3, would not in general argue efficient use of the first-stage propellants; but Centaur is yet another American compromise, in which the greatly superior specific impulse of the upper-stage propellants means that some first-stage efficiency can be advantageously sacrificed for a larger upper stage.

A figure of 700,000lb for Lunik thrust has been widely quoted, with the authority of Dr Keith Glennan, former Administrator of NASA, who said: "Soviet scientists have had at their command a rocket which our scientists and engineers estimate is in the 600,000 to 800,000lb-thrust range. They have spoken of multi-stage launch vehicles, and some of their mission accomplishments would indicate that they have used upper stages with these very powerful first-stage rockets." Dr Glennan's remarks relate to Phase I of the Russian programme.

How could this increase of first-stage thrust have been obtained, assuming basic first-stage design did not vary throughout Phase I? It might have been within the development potential of the engines, or it might have been obtained by the attachment of booster units. Judging from alleged photographs of Russian rockets the latter is a frequent technique; many of their rockets must be expressly designed to accommodate these boosters.

This picture coincides broadly with a description in a Czech journal, which suggested that the first-stage thrust of Lunik 1 was 600,000lb—440,000lb main engine plus two auxiliary motors each producing 80,000lb. The two auxiliaries were ignited at about 2,000m (6,560ft).

It is of interest that these figures for the Phase I launching vehicle—about 500,000lb first-stage thrust in the initial two-stage form, 700,000lb in the final three-stage form—agree with unofficial reports of the so-called T-3 and T-3A Russian ICBMs. The inference is apparently that these two related missiles have been accepted by Western intelligence sources as the launchers of the first three Sputniks and the three Luniks respectively, and that their main characteristics have been decided on the basis of their performances in these space experiments.

Much more information about the precise achievements of contemporary rocket technology would be available to Western intelligence bureaux than to the public. Here we have been making estimates on a rough order of magnitude basis, but we may not be very much less accurate, for Russian rocket technology is in an almost unknown state of development. We can only see its results.

The Phase II vehicle

We turn now to the Phase II launching vehicle. Many general considerations have a bearing on our ideas of the size of this rocket. We have already seen that there is a strong case for believing that it was designed to send the 10,500lb spaceship-satellite on a variety of missions. Almost certainly, therefore, it would need to be able to accelerate it to near-escape velocity. Much comment in the Soviet Press lends support to this thesis. For example, Maj Gagarin is reported to have said that the rocket could orbit payloads several times greater than the spaceship-satellite. We are also told officially that the quantity of propellants for the manned orbital launch was more than 100 times the payload weight. So we have here a rocket of comfortably over 1,000,000lb take-off weight, even for a mission which is not assumed to represent its ultimate capability. The apparently large ratio of fuel to payload may be a further indication that the rocket was designed for bigger jobs, and not at its most efficient with this relatively small payload.

So far the picture is of a rocket fully comparable in size and capabilities with the US Saturn. In its initial C-1 form Saturn is estimated to have a close-orbit payload capability of 20,000lb, and in the later C-2 form 45,000lb. To pursue the comparison, the minimum liftoff thrust of the Russian rocket must be about 1,300,000lb, in view of the weight of at least 1,000,000lb of the version which put Gagarin into orbit; and in later applications the rocket will probably weigh substantially more. But Saturn's performance depends on the use of high-energy propellants in the upper stages. If the Russians are relying on conventional propellants their rocket will need to be appreciably heavier to produce equivalent performance. In this case 2m to 2.5m pounds is a conservative estimate for the first-stage thrust.

What information can we extract from the figures the Russians gave the Fédération Aéronautique Internationale in support of their record claim? A precise translation of part of their submission states: "at launching, the rocket had six engines with total power of 20,000,000 h.p." It is difficult to make much of the horsepower figure. It is ambiguous. In determining the significance of the six engines, the configuration is the first problem—how many stages were there, in series or parallel? It is not necessarily implied that all six engines were clustered for first-stage propulsion. In fact it clearly seems that there were six engines all-told, and for all six to be operating at liftoff a completely parallel stage-configuration would be required. Gagarin's own accounts have told of the stages falling away "one after the other," suggesting a three- or four-stage rocket. One would not easily accept the possible maximum of six or even five stages. A two-stage vehicle would probably be adequate for the given close-orbit mission; but what the Russians have created is a space rocket for other and more ambitious projects, for which it is logical to suppose three or four stages in optimum relationship.

Photographs from the film of Gagarin's flight show the *Vostok* with what is apparently the final stage of the carrier-rocket, closely resembling the final stage of Lunik 2. If we accept that this resemblance implies a single engine, as on Lunik 2, then for the two or three lower stages of the vehicle we have five engines. Many configurations are possible. Particularly interesting is a parallel combination of the five engines for first-stage propulsion, with transition to subsequent stages by discarding engines with or without corresponding sections of tankage. Advantages of this configuration are the theoretically higher efficiency of parallel staging, and the elimination of the need for in-flight ignition of multi-engined upper stages. It may also account for the appendages looking like boosters or accessory tanks which, as previously noted, frequently appear in photographs of Russian rockets.

One further conjecture. A reference has been reported in a Czechoslovak journal to a Soviet rocket engine developing 1,000 metric tonnes thrust, i.e., 2,204,900lb. Such an engine might be at the centre of the cluster of five, being discarded to leave four engines sustaining the second stage of operation. A reasonable estimate for the total thrust of these four engines is somewhere in the region of 500,000lb, which gives a total first-stage thrust of roughly 2,700,000lb. Mr Val Cleaver of Rolls-Royce has pointed out that the most technically meaningful interpretation of the quoted 20,000,000 h.p. is on the basis of dissipation of kinetic energy in the exhaust, in which interpretation it corresponds to a thrust of some 2,730,000lb. (Strictly this applies to all six engines, but the final-stage engine makes a relatively negligible contribution to the sum of the thrusts.) These figures are all approximate, the horsepower quoted by the Russians probably being much rounded-off.

To sum up, in the Phase II launching vehicle we have a rocket of three, and possibly four, stages. These provide it with considerably greater potential than necessary for the close-orbit *Vostok* mission. If based on conventional propellants, its liftoff thrust is likely to be at least 2,000,000lb.

How does this rocket match up to the future needs of the Russian space programme? It certainly looks as though the Russians intend to put a man on the Moon by 1967, and possibly before. They intend to have men on Venus and Mars in the early 1970s.

MAIN EVENTS OF RUSSIAN SPACE PROGRAMME

Phase I		
Sputnik 1	Oct. 1957	First Earth satellite
Sputnik 2	Nov. 1957	Dog-carrying satellite
Sputnik 3	May 1958	Physical experiments satellite
Lunik 1	Jan. 1959	Lunar near-miss
Lunik 2	Sept. 1959	Lunar impact
Lunik 3	Oct. 1959	Photographed back of moon
Phase II		
Space-rocket tests	Jan. 1960	Two ballistic firings into Pacific
Sputnik 4	May 1960	First spaceship-satellite
Space-rocket tests	July 1960	Two further firings into Pacific
Sputnik 5	Aug. 1960	Spaceship carrying dogs. Recovered
Sputnik 6	Dec. 1960	Spaceship carrying dogs. Not recovered
Sputnik 7	Feb. 1961	14,295lb satellite, function undisclosed
Sputnik 8	Feb. 1961	Parking-orbit satellite for Venus probe
Sputnik 9	Mar. 1961	Spaceship with dog. Recovered
Sputnik 10	Mar. 1961	Spaceship with dog. Recovered
Vostok 1	Apr. 1961	First manned orbital flight
Vostok 2	Aug. 1961	Seventeen manned orbits

If the lunar mission is to be fulfilled by a chemical rocket with conventional propellants and direct transfer, a vehicle weighing tens of thousands of tons—of the order of 50,000—at launching seems inevitable. Propellants of higher energy would bring this figure down very considerably, but not below about 4,000 tons.

This is not an impossible perspective, but it is most improbable. What we are looking for is a reasonable "next step" which would carry us from the present state to the realization of manned lunar landing. The time-scale we have in mind does not permit more than one major "next step" in rocket technology. In this sense the all-chemical, direct-transfer method does not seem to be a logical "next step."

The alternatives are orbital rendezvous—flight refuelling on a parking orbit—rendezvous on the lunar surface, or the use of a direct-transfer vehicle based on the present Phase II vehicle with one or more nuclear intermediate stages.

Each of these is a conceivable next step. The existing Phase II vehicle should be big enough to make orbital rendezvous a relatively simple technique, in that not more than five vehicles would have to rendezvous. Rendezvous on the lunar surface looks less likely.

It will not be long before the course of events reveals whether orbital rendezvous is the method selected. If it is, experiments must begin soon. That we have reached the present date without any orbital-rendezvous experiments by the Russians may be taken as favouring the nuclear hypothesis, for a nuclear stage could be thoroughly tested and developed without recourse to orbital experiments. On previous form the Russians prefer this type of progress, and their rockets have been very reliable by the time of operational employment. The first orbital-rendezvous experiments might reveal unanticipated difficulties.

Current development of either orbital-rendezvous techniques or a nuclear rocket would go far to justify confidence in the achievement of manned lunar exploration before the 1960s are out. Unless experiments in orbital rendezvous are made before long, it would seem that nuclear stages combined with the existing giant chemical rockets constitute the selected option—if we are not tantalizing ourselves with unreal hopes.

SPACECRAFT SCOREBOARD 1961

Following on from the two previous lists in *Flight* of August 28, 1959 and August 5, 1960, the period covered on these pages is from July 29, 1960 to August 11, 1961. The "Orbit" column gives the initial perigee and apogee, and the period quoted is the initial period of the satellite. The weight quoted is normally total weight, with scientific payload in parentheses where known.

Spacecraft	Launch vehicle	Date and place	Shape	Weight (lb)	Incln (deg)	Orbit (miles)	Period (min)	Purpose	Radio (Mc/s)	Remarks
Discoverer 13 (1960 Theta)	Thor-Agena	Aug. 10, 1960 Vandenberg AFB	cylinder 19.2ft × 5ft dia	1,700 (300)	82.85	161-436	94.1	obtain data on propulsion, communications, orbital performance, recovery techniques and advanced engineering tests (USAF)	not disclosed	capsule ejected and recovered from sea, August 11
Echo 1 (1960 Iota)	Thor-Delta	Aug. 12, 1960 Cape Canaveral	inflatable sphere 100ft dia	240 (132)	47.2	945-1,049	118.3	use inflatable sphere as reflector in passive communications satellite test (NASA)	108.06 107.94	voice transmissions successfully reflected
Discoverer 14 (1960 Kappa)	Thor-Agena	Aug. 18, 1960 Vandenberg AFB	cylinder 19.2ft × 5ft dia	1,700 (300)	79.6	116-502	94.5	obtain data on propulsion, communications, orbital performance, recovery techniques and advanced engineering tests (USAF)	not disclosed	capsule ejected and recovered in mid-air, August 19
Sputnik 5 (1960 Lambda)	multi-stage rocket	Aug. 19, 1960	cylinder?	10,120	64.57	190-211	90.72	test safety of capsule and recovery system for ultimate development of manned spaceflight system (USSR)	19.995	capsule and carrier recovered August 20 on 18th orbit: carried two dogs, rats, mice, flies, plants, fungi, microscopic water plants and seeds: reported to have landed less than 10 km from planned point
Discoverer 15 (1960 Mu)	Thor-Agena	Sept. 13, 1960 Vandenberg AFB	cylinder 19.2ft × 5ft dia	1,700 (300)	80.93	130-472	94.24	systems test including launch technique, propulsion, communications, orbital performance, advanced engineering tests and recovery techniques (USAF)	not disclosed	capsule ejected and sighted in sea; recovery prevented by rough seas
Courier 1B (1960 Nu)	Thor-AbleStar	Oct. 4, 1960 Cape Canaveral	sphere 51in dia	500	28.3	501-658	107	test feasibility of global military communications network using delayed repeater satellites (US Army)	not disclosed	messages successfully relayed: capacity 60,000 words per min
Explorer 8 (1960 Xi)	Juno 2	Nov. 3, 1960 Cape Canaveral	double cone 30in × 30in dia	90,14	49.9	258-1,423	112.7	investigate ionosphere by direct measurement of positive ion and electron composition; study frequency, momentum and energy of micro-meteorite impacts (NASA)	108	instrumentation functioned, data telemetered and analysed
Discoverer 17 (1960 Omicron)	Thor-Agena B	Nov. 12, 1960 Vandenberg AFB	cylinder 25ft × 5ft dia	2,100 (300)	81.8	116-616	96.45	systems test of Agena B satellite including launch techniques, propulsion, communications, orbital performance, recovery techniques and advanced engineering tests (USAF)	not disclosed	carried radiation counter, emulsion packs to study lower Van Allen radiation; micro-organisms, plant spore and microscopic, artificially grown human cells; high-intensity light beacon for optical tracking: capsule ejected and recovered in mid-air, November 14
Tiros 2 (1960 Pi)	Thor-Delta	Nov. 23, 1960 Cape Canaveral	pillbox 19in × 42in dia	280	48.5	387-453	98.2	test experimental television techniques and infra-red equipment leading to eventual worldwide meteorological information system (NASA)	235 237.8 108 108.03	narrow-angle camera and infra-red instrumentation transmitted good data: wide-angle photograph quality not good
Sputnik 6 (1960 Rho)	multi-stage rocket	Dec. 1, 1960	cylinder?	10,060	65	112-155	88.6	test equipment for eventual manned spaceflight (USSR)	19.995	carried two dogs and other animal and plant life: craft descended on unplanned trajectory when signalled to re-enter, and burned up in dense atmosphere
Discoverer 18 (1960 Sigma)	Thor-Agena B	Dec. 8, 1960 Vandenberg AFB	cylinder 25ft × 5ft dia	2,100 (300)	80.9	154-459	94.1	systems test of Agena B satellite including launch techniques, propulsion, communications, orbital performance, recovery techniques and advanced engineering tests (USAF)	not disclosed	carried algae, bone marrow, eyelid membrane, gamma globulin, spores, gold foil, analine powder and other material for medical and technical experiments; and light beacon for tracking experiment: capsule ejected and recovered in mid-air, December 10
Discoverer 19 (1960 Tau)	Thor-Agena B	Dec. 20, 1960 Vandenberg AFB	cylinder 25ft × 5ft dia	2,100	83.4	128-323	92	systems test of Agena B satellite; collect data on atmospheric phenomena and infra-red radiation in Earth's atmosphere in support of programmes such as Midas (USAF)	not disclosed	instrumentation included scanner, preset for specific wavelength, to measure intensity of infra-red radiation, and instruments to measure heat intensity of certain microwave bands. Transmissions ceased December 25
Samos 2 (1961 Alpha)	Atlas-Agena A	Jan. 31, 1961 Point Arguello	cylinder 22ft × 5ft dia	4,100	approx. polar	approx. 300-350	approx. 95	determine capabilities for making observations of space, the atmosphere and the nature of the globe from satellites (USAF)	not disclosed	carried photographic and related test equipment, also telemetry, tracking and command equipment
Sputnik 7 (1961 Beta)	multi-stage rocket	Feb. 4, 1961	not disclosed	14,292	65	139-204	89.8	develop and place heavy spacecraft in precise orbit (USSR)	not disclosed	equipment functioned normally: instrumentation included telemetry system for structural parameters and "equipment for trajectory measurements"
Sputnik 8 (1961 Gamma 3)	multi-stage rocket	Feb. 12, 1961	not disclosed	assumed similar to Sputnik 7	65	138-174	89.6	test orbital launch technique for space probe (USSR)	not disclosed	Venus probe successfully launched
Venus probe (1961 Gamma 1)	single-stage rocket	Feb. 12, 1961 launched from Sputnik 8	complex	1,419	0.3 to ecliptic	66.7m to 94.6m from Sun	300 days	reach vicinity of Venus, test long-range communications, provide measurements of solar system, make physical observations of outer space (USSR)	922.8	radio contact lost on attempt to re-establish contact from Jodrell Bank: inconclusive
Explorer 9 (1961 Delta)	Scout	Feb. 16, 1961 Wallops Island	inflatable sphere 12ft dia	80	38.63	395-1,605	118.3	(1) study performance, structural integrity and environmental conditions of Scout research vehicle and guidance-control system; (2) determine atmospheric density at orbits of	136	transmitter on balloon failed to function, requiring optical tracking: first satellite launch by all-solid rocket: first from Wallops Station
Discoverer 20 (1961 Epsilon)	Thor-Agena B	Feb. 17, 1961 Vandenberg AFB	cylinder 25ft × 5ft	2,450 (300)	80.43	177-486	95.4	systems test of Agena B satellite; test of modified satellite stabilization system (USAF)	not disclosed	equipment malfunction prevented capsule recovery attempt: carried Smithsonian optical tracking experiment, Transit tracking beacon

(1961 Gamma 1)	rocket	launched from Sputnik 8	complex	1,419	0.5 to ecliptic	66.7m to 94.6m from Sun	300 days	reach vicinity of Venus, test long-range communications, provide measurements of solar system, make physical observations of outer space (USSR)	922.8	radio contact lost on attempt to re-establish contact from Jodrell Bank: inconclusive
Explorer 9 (1961 Delta)	Scout	Feb. 16, 1961 Wallops Island	inflatable sphere 12ft dia	80	38.63	395-1,605	118.3	(1) study performance, structural integrity and environmental conditions of Scout research vehicle and guidance-control system; (2) determine atmospheric density for orbit of	136	transmitter on balloon failed to function, requiring optical tracking: first satellite launch by all-solid rocket; first from Wallops Station
Discoverer 20 (1961 Epsilon)	Thor-Agena B	Feb. 17, 1961 Vandenberg AFB	cylinder 25ft × 5ft dia	2,450 (300)	80.43	177-486	95.4	systems test of Agena B satellite; test of modified satellite stabilization system (USAF)	not disclosed	equipment malfunction prevented capsule recovery attempt: carried Smithsonian optical tracking experiment, Transit tracking beacon
Discoverer 21 (1961 Zeta)	Thor-Agena B	Feb. 18, 1961 Vandenberg AFB	not disclosed	not disclosed	80.74	149-659	93.8 approx. (97.8 after re-start)	obtain engineering and research data on atmospheric phenomena and infra-red radiation in Earth's atmosphere in support of Air Force early-warning satellite system; test satellite stabilisation and control system (USAF)	not disclosed	Agena engine re-started in space for first time during Earth orbit
Transit 3B (1961 Eta)	Thor-AbleStar	Feb. 21, 1961 Cape Canaveral	sphere 36in dia	250 approx.	28.36	117-511	94.5	develop all-weather global navigation system; increase accuracy of geodetic measurement (USN)	54 324 162 216	attempted launch of two satellites by one launch vehicle; orbit achieved but satellites failed to separate; both transmitters worked, but elliptical orbit hampered quality of transit data
LOFTI 1 (1961 Eta)			sphere 20in dia	57				measure intensity of VLF signals through one-sphere (USN)	136	
Sputnik 9 (1961 Theta)	multi-stage rocket	March 9, 1961	not disclosed	10,340	64.9	115-155	88.6	further test of spacecraft and systems for manned flight; test influence of cosmic radiation on living beings (USSR)	not disclosed	carried one dog, guinea pigs, mice, insects and seeds: cabin ejected and recovered in predetermined area
Sputnik 10 (1961 Iota)	multi-stage rocket	March 25, 1961	not disclosed	10,330	64.9	111-150 approx.	88.4	further test of spacecraft and systems for manned flight (USSR)	not disclosed	carried one dog and other animals: cabin ejected and recovered in predetermined area
Explorer 10 (1961 Kappa)	Thor-Delta	March 25, 1961 Cape Canaveral	13in sphere tube-connected to 19in cylinder 52in high	79	33	100-145 000 approx.	112hr approx.	study Earth and interplanetary magnetic fields and interaction with solar plasma (NASA)	108	data transmitted for 60hr: equipment included rubidium vapour magnetometer, two fluxgate magnetometers, plasma probe and optical aspect sensor
Discoverer 23 (1961 Lambda)	Thor-Agena B	April 8, 1961 Vandenberg AFB	cylinder 25ft × 5ft dia	2,100 (300)	81.94	126-882	101.2	systems test of Agena B satellite, particularly recently changed guidance, stabilizing and propulsion components; improve ability to control orbital period (USAF)	not disclosed	capsule separated but did not re-enter following stabilization problems: satellite carried lights for Smithsonian tracking experiment
Explorer 11 (1961 Nu)	Juno 2	April 27, 1961 Cape Canaveral	12in dia, 23¼in long octagon on 6in dia, 20½in long column; 44in long fourth stage attached	82	28.8	304-1,113	108.1	gamma-ray astronomy telescope to detect high-energy gamma rays from cosmic sources and map their distribution in the sky (NASA)	107.97 108.06	vehicle and payload functioned as planned
Discoverer 25 (1961 Xi)	Thor-Agena B	June 16, 1961 Vandenberg AFB	cylinder 25ft × 5ft dia	2,100 (300)	82.11	139-252	90.87	systems test of Agena B, particularly recently changed components; improvement of orbital period control; ejection and recovery of capsule (USAF)	not disclosed	capsule ejected and recovered from sea, June 18; contained rare and common metals for study of space effects, also instruments to measure radiation and micro-meteorites
Transit 4A (1961 Omicron 1)	Thor-AbleStar	June 29, 1961 Cape Canaveral	16-sided, 43in dia polygon, 31in high, flat top and bottom	175	67	534-623	103.7	develop all-weather global navigation system: launch three satellites by one vehicle (USN)		carried memory system, electronic clock, and four transmitters, two of which powered by nuclear generator
Greb 3 (1961 Omicron 2)			sphere 20in dia	55	67	534-634	103.8	measure solar X-radiation (US Naval Research Laboratory)		carried two X-ray detectors, one transmitter: failed to separate from Injun
Injun (1961 Omicron 2)			cylinder 13in × 16in dia	40				measure cosmic radiation intensity (State University of Iowa)	136.2	carried 12 particle and proton detectors, one transmitter: failed to separate from Greb 3
Discoverer 26 (1961 Pi)	Thor-Agena B	July 7, 1961 Vandenberg AFB	cylinder 25ft × 5ft dia	2,100 (300)	82.93	146-503	95	systems test of Agena B, particularly recently changed components: improvement of orbital period control; ejection and recovery of capsule (USAF)	not disclosed	capsule ejected and recovered in mid-air, July 9: carried chemical elements to assess effects of space environment, erosion gauge and micro-meteoroid detector
Tiros 3 (1961 Rho)	Thor-Delta	July 12, 1961 Cape Canaveral	cylinder 19in × 42in dia	285	47.8	461-506	100.4	(1) develop satellite weather observation system; (2) obtain photographs of Earth's cloud cover with two wide-angle cameras; (3) determine amount of solar energy absorbed, reflected and emitted by Earth (NASA)	235 237.8 108 108.03	cameras and infra-red instrumentation transmitted good data; one camera ceased to function, July 24
Midas 3 (1961 Sigma)	Atlas-Agena B	July 12, 1961 Point Arguello	cylinder 30ft × 5ft dia	3,500 approx	91.2	2,129-2,153	161.5	overall test of system for detecting missile launchings with satellite-borne sensors (USAF)	not disclosed	payload details not disclosed: Agena B re-started in flight to boost altitude

THE *column-heading "Astronaut" appears for the first time in this, our third annual summary of satellites and probes successfully launched. The following space vehicles were in orbit at the time of going to press (August 11): Explorer 1, Vanguard 1, Lunik 1, Vanguard 2, Pioneer 4, Explorer 6, Vanguard 3, Explorer 7, Pioneer 5, Tiros 1, Transit 1B, Sputnik 4, Midas 2, Transit 2A, Greb 1, Echo 1, Courier 1B, Explorer 8, Tiros 2, Samos 2, Soviet Venus probe, Explorer 9, Discoverer 20, Discoverer 21, Explorer 10, Discoverer 23, Explorer 11, Discoverer 25, Transit 4A, Injun/Greb 3, Discoverer 26, Tiros 3 and Midas 3. Of these Vanguard 1, Explorer 7, Tiros 1, Midas 2, Transit 2A, Courier 1B, Tiros 2, Explorer 11, Transit 4A and Injun/Greb 3, Tiros 3, and possibly Midas 3 were still transmitting data.*

Spacecraft	Astronaut	Launch vehicle	Date and place	Shape	Weight (lb)	Type of flight	Distance (miles)	Height (miles)	Duration (min)	Remarks
Vostok (1961 Mu)	Maj Yuri A. Gagarin Soviet Air Force	six-engined, thrust of "20m h.p."	April 12, 1961 Baykonur, W. Siberia	cylin-drical	10,416	orbital 65.07° incln 89.1min period	one orbit	109-188	108	first manned orbital flight: spacecraft landed near Smelovka, Saratov district, 500 miles south-west of Moscow
Freedom 7	Cdr Alan B. Shepard USN	Redstone	May 5, 1961 Cape Canaveral	cone-cylinder	2,250	sub-orbital	302	115	15	first US manned ballistic flight (NASA Project Mercury)
Liberty Bell 7	Capt Virgil I. Grissom USAF	Redstone	July 21, 1961 Cape Canaveral	cone-cylinder	2,250	sub-orbital	303	118	16	capsule sank in sea after escape-hatch explosive bolts fired
Vostok 2 (1961 Tau)	Maj Herman S. Titov Soviet Air Force	assumed as for Vostok	August 6, 1961 assumed Baykonur	cylin-drical	10,430	orbital 64.9° incln 8.6min period	17 orbits	110-160	1,518	first manned multi-orbital flight; spacecraft landed Saratov district

Straight and Level

For goodness' sake (some publicity managers are always telling their photographers) can't you take pictures with a bit more life and action? So ten out of ten to the Fairey photographer who took this picture at Westland's private heliport at Battersea on August 3. I leave it to you to speculate on what these people are saying, doing or thinking: to be serious, the occasion was a special BEA Whirlwind flight arranged by the Ministry to enable London county councillors to see the proposed sites for a permanent London heliport

THE esteemed Editor of the American publication *Airlift*, Mr Wayne Parrish, made generous reference in his August issue to a recent plaint of mine about passenger handling at London Heathrow. He mentioned incidentally that Roger Bacon is a pseudonym for Hugh Ramsden.

I can assure Mr Parrish, and everybody else, that there is no such person as Hugh Ramsden. At least there may be, somewhere in the world; but he doesn't write this column, nor does he have anything whatsoever to do with this column.

If any secret-smasher wants to know who Roger Bacon is, let him turn to *Who's Who* for 1262. He will find that, among my many accomplishments, I was the first man to write anything sensible—in any language—about aviation. But of course that was a long time ago.

I will now reveal a startling truth to an amazed world: Wayne Parrish is a pseudonym for Sir Fred Boost.

● Dr J. Nit, British air expert, announced the formation of an independent Authority to take over the Ministry of Aviation at a press conference last week held in the Air Power Club's Brochure Room.

"It is to be called the Committee Authority," said Dr Nit, "and it will be made up entirely of committees. All who care for the British way of life will, I am sure, approve when I say that urgency and decision will have no part in the new Authority's deliberations.

"Indeed, its very title seeks to convey an attitude of nineteenth-century detachment, of aristocratic aloofness and—why be ashamed to admit it?—old-fashioned reaction to all the rather vulgar and unseemly urgency of such problems as heliports for London, supersonic airliners and all the rest of it. A whole range of committees will be set up and will from time to time make tentative demi-propositions on these matters; their terms of reference will be specifically framed to avoid any danger of a firm decision being reached."

At this point the audience, led by Sir Charles Boost, began to sing *Rule Britannia* so loudly that the magnificent Adam ceiling of the Brochure Room started to disintegrate. Firemen and mounted police had to be called in to restore order, and a committee was immediately formed to discuss the question of finding new premises.

Footnote. Thinx Electronics Ltd announced last week an order from the new Authority for 58 Model O-2201 Committee Simulators.

● All *Flight*'s readers are, by definition, well read. They must therefore know about James Joyce and his stream-of-consciousness. Here is a Roger Bacon stream-of-unconsciousness, which may or may not be confluent with that of our Air Transport Licensing Board.

Thinks: Airlines appear before the Board as equals . . . Well, they do *seem* to be equals, corporations and independents . . . Pretty impressive advocate that independent's got . . . Certainly seems to know what he's talking about, wonder where he has his suits made . . . That was a good point he scored off BEA, ha ha!

Further thinks: Steady on, chaps, something not quite fair here . . . BEA are on the defensive . . . Why *should* they be on the defensive? . . . Why should they have to say "Look at our achievements"? . . . Why should they have to justify criticisms? . . . The independents don't have to justify criticisms; they haven't done anything worth criticizing yet . . .

Final thinks: BEA have more expertise in air transport than all the independents put together $\times 10^6$ . . . They may appear before the Board as equals, but they are *not* equals, not by a long chalk . . . We're putting an honest and conscientious citizen in court and threatening to deprive him of his livelihood if he can't prove he isn't guilty—Bah!

There, I feel much better now.

● From *The Guardian* report on the attempted seizure by Leon Bearden and his son Cody of Continental Airlines 707:

"Bearden's wife, Maryn, aged 36, said she was surprised by her husband's behaviour. He had never mentioned Cuba, never expressed an interest in aircraft, and had no guns around the house."

● Opening sentence of *The Times* report on continued unrest at London Airport: *"British Overseas Airways Corporation were accused by union leaders yesterday of 'working to rule' . . ."*

ROGER BACON

At a recent open day at RNAS Abbotsinch this Thing, billed as the Navy's latest secret weapon, taxied out for take-off. After running half-way down the runway the pilot discovered a snag and abandoned the demonstration. The snag? If you can't guess the answer is . . .

It's got a Sea Venom fuselage (modified) and wings, and Gannet fins

Correspondence

The Editor of "Flight" is not necessarily in agreement with the views expressed by correspondents in these columns. Names and addresses of writers, not for publication in detail, must in all cases accompany letters.

Pooling Agreements

I AM not sure whether we are supposed to take "Straight and Level" seriously, but Roger Bacon's creation of a mystery about pools (August 3) cannot pass without comment.

The question which was posed to the Air Transport Licensing Board was whether BEA's pooling arrangements with other European airlines are secret agreements (and hence, by implication, of insidious intent) or whether they are subject to public control by Ministerial approval.

BEA answered categorically that its pooling agreements are known to and approved by Her Majesty's Government. This was confirmed by the letter which BUA received from the Ministry of Aviation in reply to a contemporaneous enquiry very similar to that sent by Roger Bacon. The Ministry's letter, of which copies were sent to all parties to the hearing, said that the Ministry had been kept informed of the essential contents of BEA's commercial and pooling agreements. This reply should be read in conjunction with Mr Duncan Sandys' statement in the House of Commons that "these pooling arrangements have proved valuable in eliminating wasteful duplication and promoting productive co-operation and harmonious international relations," and that he would certainly take care to see that nothing was done to upset these arrangements.

Roger Bacon is entitled to think what he likes about pools, but the facts clearly show that the Ministry of Aviation know and approve the terms of BEA's pooling agreements.

Ruislip, Middx — HENRY MARKING, Secretary, British European Airways

[A note on this letter appears on page 240]

MEA Profits

IN your review (August 3) of BOAC's annual report, 1960-61, reference is made to "small losses" incurred by Middle East Airlines. I would like to point out that audited accounts for MEA show a profit for both 1959 and 1960. BOAC's report does not, perhaps, make it clear that MEA's accounts are audited for a calendar year and not for the financial period April-March. The £134,312 loss reported by MEA for the first three months of 1961 is due to a seasonal drop in traffic and is not likely to reflect the financial position of the airline at the end of this year.

London W1 — GAVIN COCHRANE, Middle East Airlines

Flying Scale Models

WITH reference to Mr D. E. Thompson's most interesting letter and photograph published in your June 15 issue, it has occurred to me that a number of your readers might be equally interested to see the attached photograph [reproduced below—Ed] of a remarkable flying model of a Super Constellation in Eastern Airlines livery.

Built last year by Mr Thomas Lindsey (of Evansville, Indiana, USA), it was the result of just under one thousand hours in research and actual construction: completing and painting the realistic airline markings alone took him no less than three weeks. Built to 1/20th scale, this control-line Super-Connie has a wing span of 73¼in, an overall length of 67¼in, and all-up weight of 12¾lb. It has reached a top speed of 50 m.p.h. in flight. The owner flies it with a 70ft-long control line, attached to a handle that actuates a bell crank located slightly aft of the c.g. in the centre-section. A ¼in-diameter piano-wire push-rod connected from the bell crank to a control horn moves the elevators up and down.

Mr Lindsey's long and painstaking research studies included visits to Eastern Airlines' Miami maintenance base and study of a Lockheed engineering manual. A small number of parts from a Monogram plastic kit were used in the construction. Altogether a remarkably beautiful engineering job, so much so that Eastern Airlines themselves devoted to it a page-and-a-half in a recent issue of their house journal.

Nairobi, East Africa — DENNIS M. POWELL

The Super Constellation model described by Mr Dennis Powell. For the photograph it appears to have been placed in front of a real control tower

Oblt Moritz Kaye-Nein (centre) with Baron von Richthofen and pilots of the "circus" after receiving his award in 1917. (See "Aeronautical Dogmatism")

Aeronautical Dogmatism

WHERE has Mr Stroud (Correspondence, August 3) been hiding? How can he be so out of touch with things aeronautical as to imply that dogs dislike aeroplanes and have contributed little or nothing to aviation?

Even his concession that they are interested only in VTOL (London to Paris by Viscount) hardly does justice to the sacrifices of the two Soviet Sputnik-travellers of recent times. Mr Stroud cannot lightly dismiss their exploits by saying "Ah, but they didn't *do* anything." With both hind legs strapped to the floor, "doing anything" would only be within the capabilities of a contortionist. Let us not be churlish, Mr Stroud, but rather show generous appreciation of their restraint and/or stick-to-it-ivness.

If I may conclude on a personal note, I would draw readers' attention to the enclosed photograph [reproduced above—Ed], which features my revered uncle, Oblt Moritz Kaye-Nein, receiving the congratulations of his CO, the famous Manfred von Richthofen (centre, right), and pilots of the "Richthofen Circus." The occasion was the award, in 1917, to my relative of the "Eisern Laternenpfahl" (1st class) for gallantry in the numerous dog-fights of that year. Of course, a number of other dogs flew in this Geschwader, amongst them Ernst Udet, who was a "gay dog," and Hermann Goering.

I remain, Sir, yours dogmatically,

Alte Dreipaderhof, Pomerania — KURT KAYE-NEIN

FORTHCOMING EVENTS

Aug 19	Lancashire Aero Club: Open Day, Barton.
Aug 27	Forli Rally.
Aug 27-Sept 3	Swedish Parachute Club: International Contest, Uppsala.
Sept 3	Wolverhampton Aero Club: At Home.
Sept 3-14	8th Anglo-American Aeronautical Conference (joint IAS/RAeS/CAI), London.
Sept 4-10	**SBAC Exhibition and Flying Display, Farnborough.**
Sept 6-10	FAI: European Air Tour.
Sept 8-10	Popular Flying Association: Rally, Cranfield.
Sept 9	British Air Mail Society: Golden Jubilee Exhibition and Dinner, Windsor.
Sept 11-15	Royal College of Advanced Technology, Salford: Course on Noise Measurement.
Sept 11-17	Battle of Britain Week.
Sept 13-17	German Aero Club: 2nd International Sporting Pilots' Rally, Baden-Baden.
Sept 23-24	International Grand Prix for Light Aircraft, Bourges.
Oct 7-8	Genoa Rally.
Oct 12	Guild of Air Pilots and Air Navigators: Lecture, "Stress and Human Performance," by Air Cdre W. K. Stewart.

AIR COMMERCE

This was the scene at El Paso, Texas, on August 3 as police opened fire on a Continental Airlines Boeing 707 after an attempt was made to "hi-jack" it to Cuba. A note on the attempted piracy appears on page 239

ATLB PUBLIC MEETING 21 (Continued)

HERE is continued our summary of this important Air Transport Licensing Board hearing. As usual we have felt it right to sacrifice some topicality in order to maintain a reasonably full record of these proceedings.

CUNARD EAGLE'S application A.1054 for a service London-Dublin came next. Presenting the usual table of figures and route information, Mr Ashton Hill commented on the high traffic growth rate, the existing air services and the great disparity between the carryings of BEA and Aer Lingus. He said that there was apparently nothing in the new bilateral agreement to prevent the designation of two or even three British operators; the high traffic potential showed that there was plenty of room for additional carriers and Cunard Eagle had therefore withdrawn the objection which they had made to BUA's application.

Pressed by Mr Marking of BEA to say how many operators he thought the route could support, Mr Ashton Hill said that that would depend on BEA's future frequencies: he understood from Aer Lingus that they were at present carrying 92 per cent of the traffic and BEA only 8 per cent. Mr Marking said that Mr Ashton Hill mustn't believe all he heard.

Mr Ashton Hill, giving evidence for CEA's application for a service from Manchester and/or Liverpool to Dublin, said that Manchester-Dublin was at present served by Aer Lingus and BEA, Liverpool-Dublin by Aer Lingus only. He was briefly cross-examined by Mr Marking on proposed frequency and route to be operated and said that CEA intended to operate Manchester-Liverpool-Dublin, but might not call at Liverpool if BEA did not. He agreed that CEA might operate a separate service Liverpool-Dublin.

Mr Collingwood, witness for BEA's objection, said that the bilateral was the same as that controlling London-Dublin. It referred to Manchester and/or Liverpool; BEA were at present operating only Manchester-Dublin, but, if the traffic increased, hoped to make a call at Liverpool. It was possible that they might operate two separate routes —one Manchester-Dublin and the other Liverpool-Dublin. He agreed with the Board that Aer Lingus were already operating in this way.

Questions From The Board

In answer to further questions from the Board, Mr Collingwood said that he was doubtful when BEA could hope to reach parity with Aer Lingus. He agreed that they were short of capacity to put on this route.

Mr Ashton Hill asked whether Aer Lingus were offering six times the BEA capacity on the route; Mr Collingwood said that BEA operated seven flights weekly and Aer Lingus 46.

Re-examined by Mr Marking, Mr Collingwood confirmed that the introduction of Vanguards would clear the present shortage of capacity: the load factor during the winter 1960/61 had been under 50 per cent.

Mr Oswald next called his witness for the British Transport Commission's objections.

The next Dublin application was A.1119, by Starways, for a service from Chester to Dublin. The Board was informed that the Welsh Advisory Committee strongly supported the application. Mr Nance presented the application. He said that this was a new development; there was at present no service from the Chester area to Dublin. Licences held by Starways covered Hawarden (Chester) but they could not develop regular services there owing to lack of facilities. They had had discussions with the de Havilland Company, who were prepared to provide all the technical facilities needed if Starways could guarantee that landing fees would bring them in approximately £5,000 per annum; Starways would themselves provide passenger handling facilities.

Captain G. K. Leigh, general manager of Starways, said that they had been interested for two years in the possibility of developing Hawarden and wanted to run services from that airfield to Dublin, Jersey, the Isle of Man and Belfast. They had applied to the Board for various services but were unable to operate them from Hawarden because the initial development cost there would be £7,000 to £10,000. The de Havilland Company could not provide the facilities required for less than £5,000 to £6,000 per annum, about 1,200 landings per annum.

The alternative aerodromes were Liverpool—28 mies away, with the Queens Ferry, the toll and the tunnel to negotiate—and Manchester (Ringway) was 42 miles by road. There was therefore little likelihood of diversion of traffic from services operated to and from these airports. The population in the catchment area which Hawarden would serve was ½ to ¾ million.

Mr Marking cross-examined and asked Captain Leigh to state Starways' proposed frequencies; Captain Leigh said they proposed 10 flights per week with DC-3, DC-4 or Viscount aircraft. He did not know when Starways would get their second Viscount.

Speaking to the BEA objection, Mr Marking said that he had no witnesses to call, but BEA felt that there was no need for a further international airport in that part of England.

Next came application A.1134, by Overseas Aviation, for a service Jersey-Cardiff-Dublin. Mr Norman Bradshaw, sales manager of Overseas, said that they would probably start at a frequency of two flights per week with Argonauts. The IATA fares would be applied, but Overseas would like to be able to use the 17-day excursion fare any day of the week. Mr Bradshaw suggested that the Aer Lingus service from Dublin to the Channel Islands was inadequate, and there was no British operator on the route. Mr Jenkins spoke to Jersey Airlines' objection, which was based on their existing operations Jersey-Exeter and Exeter-Dublin.

Cunard's Turin Application

Business continued with the hearing of application A.1061, by Cunard Eagle, for a service between London and Turin. Mr Ashton Hill said that CEA had first applied, unsuccessfully, for a scheduled service to Turin in 1954. BEA had subsequently applied, CEA had re-applied and BEA had been licensed in 1958. There was already heavy IT traffic to Turin and this could be carried at ITX rates on a scheduled service. Mr Marking asked why Mr Ashton Hill had suggested that the opening of the service might be postponed. Mr Ashton Hill explained that the Board might suggest deferring the opening of a second service in view of the recent start of operations by BEA and the probability that the route was not yet built up.

Mr Marking then asked whether Mr Ashton Hill thought that the Italians would agree to a second British operator on the route and Mr Ashton Hill replied that present CEA schedules did not prejudice BEA under the bilateral agreement. His answers to further questions about Italian interpretation of the agreement led to the Chairman of the Board asking how all this helped. Mr Marking said that he wanted to demonstrate Italian restrictiveness; Mr Ashton Hill had implied that CEA had no difficulty in getting the rights they wanted. He then asked whether Mr Ashton Hill thought that CEA would get the Turin rights they wanted without detriment to BEA. Mr Ashton Hill said they would.

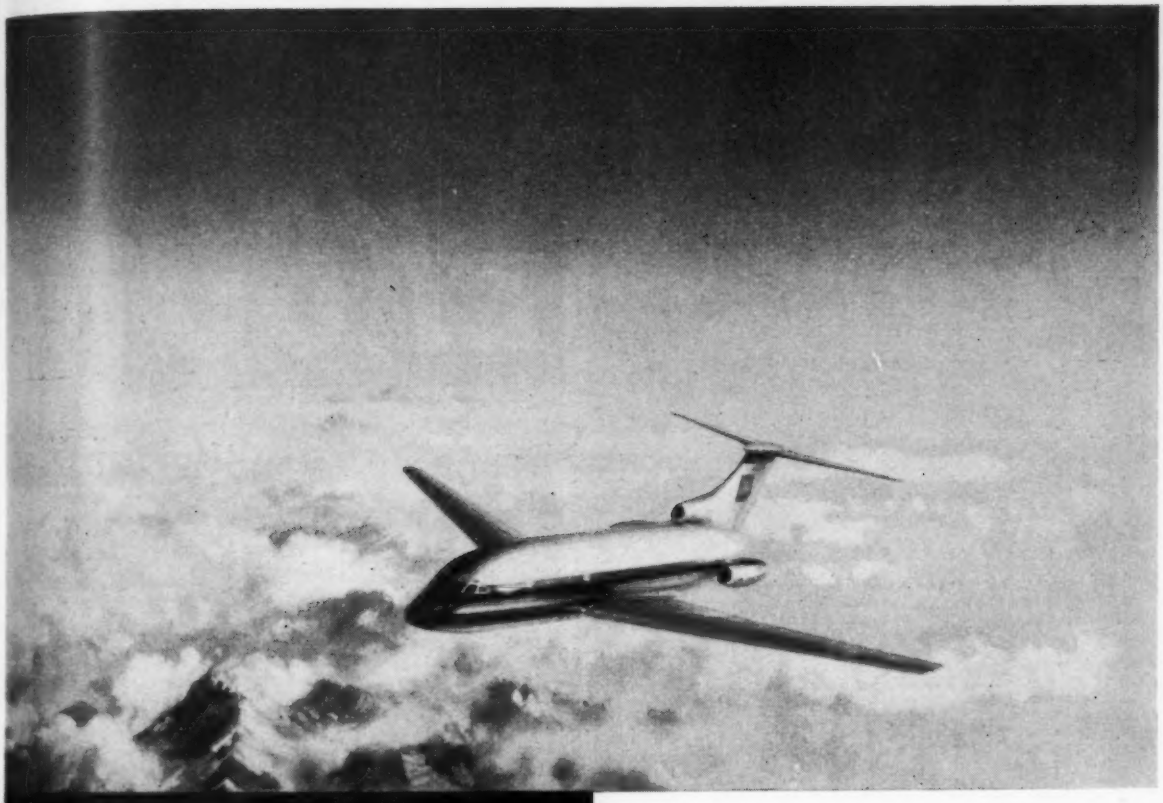
Mr Collingwood was then called as BEA's witness for their objection and was asked to explain the special implications of the bilateral.

Mr Collingwood said that the Anglo-Italian bilateral agreement gave rise to more argument than any other because British carriers were doing much better than Italy's growing airline. BEA alone operated to Turin, Naples, Sardinia and Sicily and last year carried 86 per cent of the traffic on the service to Venice, 63 per cent to Milan and 57 per cent to Rome. To this average of well over 50 per cent were to be added the 10 per cent carried by BOAC to Rome, the far from inconsiderable traffic on special IT flights, and the CEA services to Pisa and Rimini. The Italians were trying to reduce the imbalance and would be operating Caravelles Turin-London next summer. The future was likely to be harder for British operators. This applied particularly to high-frequency routes. Any services approved for independents to points already served by BEA in Italy would be at the expense of BEA's rights on the route.

Cross-examining, Mr Ashton Hill asked about BEA's interest in Alitalia and was told that they no longer have either a financial interest or representation on the board of the company. Mr Ashton Hill also made the point that CEA negotiate their own traffic rights in Italy.

A.1008, heard next, was an application by BUA for a service from Gatwick to Milan. The usual BUA document was introduced by Mr McDonnell and confirmed by Mr Whybrow. Cross-examining Mr Whybrow, Mr Marking suggested that this was a route which BEA could be expected to find profitable and had been selected by BUA for that reason. Mr Whybrow said that BEA did not make sufficient information available to permit the identification of their profitable routes. He did not accept Mr Marking's routine invitation to add to the arguments already advanced as to why BUA should be licensed.

Cunard Eagle's application, A.1059, came next, also for a service to Milan. Mr Ashton Hill said that Milan was a great centre served by



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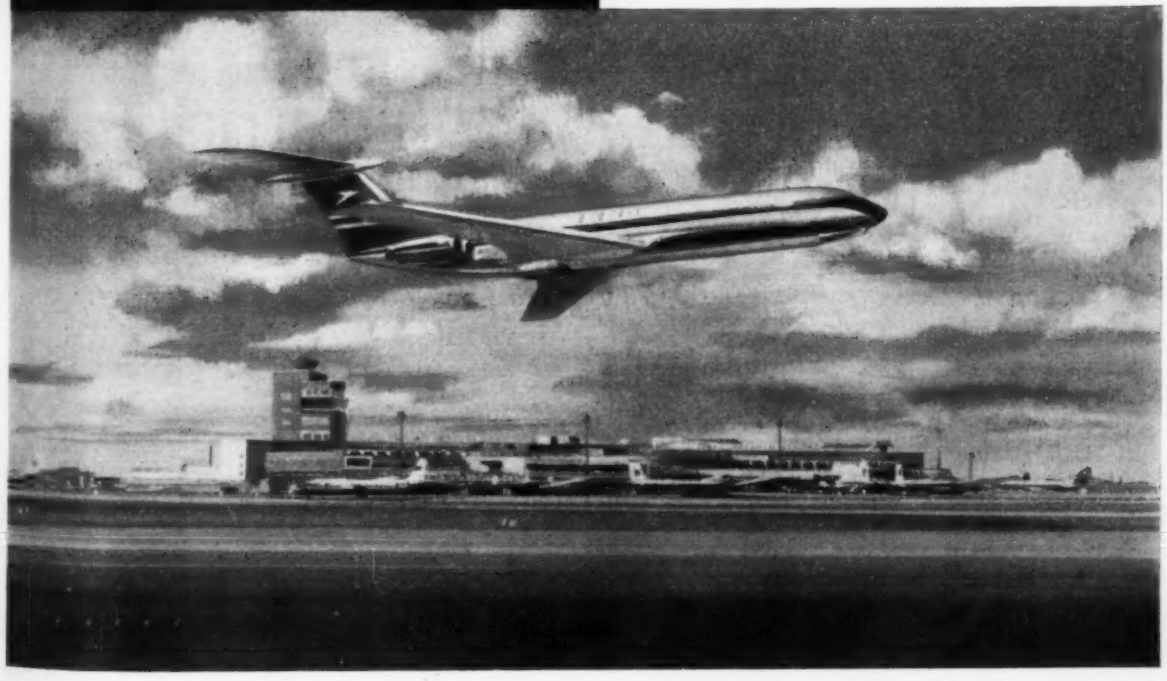

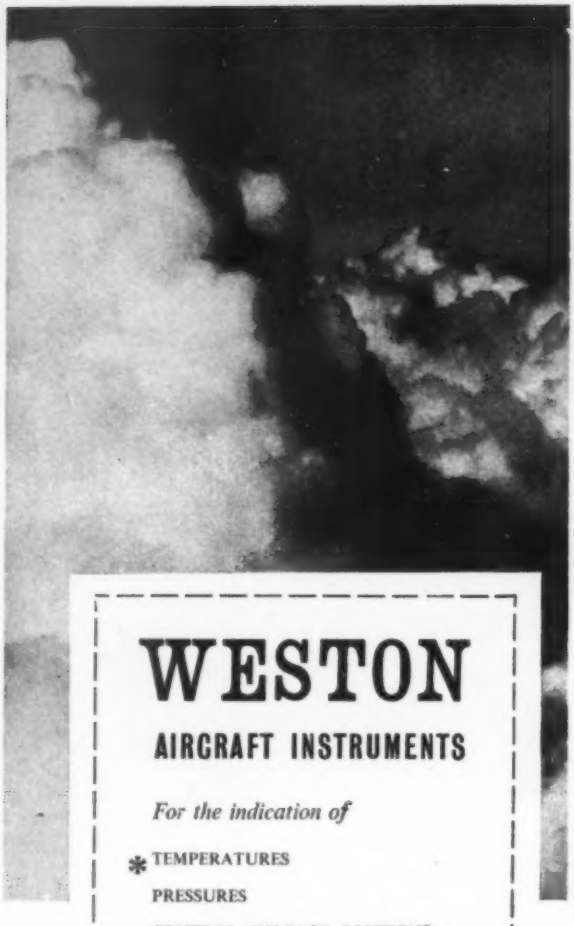

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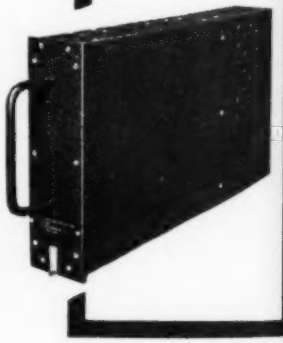

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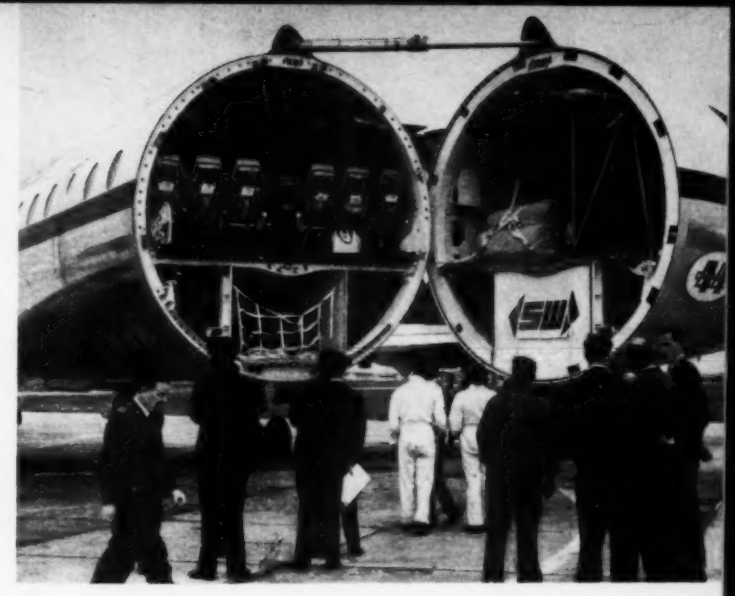


In these seats, revealed by the remarkably engineered swing tail of the CL-44, Seaboard still hope to carry passengers as "top-off" on transatlantic cargo schedules. A new application has been made to the CAB. Fare would be about £48 London - New York; it would be a strictly no-frills service, baggage allowance would be 66lb, and passengers would get six hours' notice of seat-availability

AIR COMMERCE . . .

scheduled services and many IT flights: CEA would expect to transfer their own IT traffic to the scheduled services, carrying it at ITX rates.

Mr Ashton Hill, cross-examined by Mr Marking, said he thought there was room for four operators on the route. Asked whether he thought the Italians were likely to license CEA without prejudice to BEA's rights, Mr Ashton Hill said that this old argument had been trotted out when CEA had applied for services to Pisa and Rimini. He did not know what would happen in this case but suggested that a satisfactory solution could be reached by negotiation with the Italian authorities.

Mr Collingwood was called as witness for BEA's objection to the BUA and CEA Milan applications. He said that it was, in his view, inconceivable that the Italian Government would grant rights to additional British operators without prejudice to BEA.

Turning to the question of the effects of the bilateral agreement, Mr McDonnell for BUA asked Mr Collingwood how the Anglo-Italian agreement differed from other Bermuda-type agreements. Mr Collingwood said that it was overlaid with modifications covered by a number of confidential documents.

The Board asked Mr Collingwood about the proportion of the traffic which Alitalia might be expected to carry in the future. Mr Collingwood said that he thought the Turin service would have little effect on Milan traffic; the Genoa service would be more important. He expected that Alitalia's capacity would equal BEA's within five years.

Cunard's Venice Application

Next came application A.1057, from Cunard Eagle Airways, for a service between London and Venice. Mr Ashton Hill said that the route catered mainly for seasonal tourist traffic. If they were able to start operations in 1963 CEA would probably run once weekly in the summer only. Mr Marking, in cross-examination, asked whether Mr Ashton Hill thought that the Italians, who had just reached parity with BEA on this route, would allow a British share of traffic greater than that carried by Alitalia; he suggested that the Italians would insist on cutting the BEA share to accommodate CEA. Mr Ashton Hill did not agree and said that he did not recognize the existence of a fixed British share of the traffic.

The Board next heard application A.1267, by Tradair, for a service from Southend to Venice. Cross-examined by Mr Marking, Mr Porter, after presenting his case, agreed that Tradair intended to operate a scheduled service—restricted, he added, to the carriage of ITX traffic on a round trip basis at the IATA fares.

Mr Collingwood then gave evidence for the BEA objection. He said that there was no difference in the effect of the bilateral agreement on this route.

Mr Porter suggested to Mr Collingwood that the Italian Government might continue to view the Tradair operations ("regularization of IT traffic") as special flights outside the terms of the bilateral agreement. He said that the Tradair general agent in Italy had quoted an official of the Italian Ministry of Aviation as saying that he thought the Ministry would take a liberal view. Mr Collingwood's reply indicated that he did not set much store by the opinion of an Italian civil servant.

Re-examining, Mr Marking asked his witness whether he was aware that the Director General of Civil Aviation in Italy had told Mr Milward, during the latter's recent visit to Italy, that BEA would have to accept a cut in their capacity if other British operators were licensed. There were some protests about this question and the manner in which it was put, but a member of the Board restored peace by asking whether the Director General of Civil Aviation was not also an Italian civil servant.

The next application, A.1023, for a service between Gatwick and Naples from May to October, was from BUA; Mr Whybrow confirmed the contents of the usual BUA supporting document. Cross-examining, Mr Marking suggested that BUA were seeking to skim the cream of the dense summer traffic on the route. Mr Whybrow agreed that BUA would expect an initial load factor of only 35 per cent and Mr Marking then asked whether he would agree, assuming that the BEA capacity had to be cut back by the amount of the BUA capacity, that the difference between the normal BEA load factor and BUA's 35 per cent would be a loss suffered by British civil aviation. Mr Whybrow said that, assuming all these things, he would agree. Mr Marking suggested that, on the same assumptions, any traffic carried by BUA would be traffic taken away from BEA and Mr Whybrow, with the same proviso, agreed.

Mr Porter next presented Tradair's application, A.1270, also for a service to Naples. He said that there was a large and growing demand for air travel to Naples and the local tourist board was most encouraging and anxious to press the Italian Government not to place any restrictions on tourist flights to Naples. Mr Porter therefore hoped that operations by Tradair on this route would have no effect on the bilateral.

Mr Collingwood, witness for BEA's objection, again said that he believed that BEA's capacity would have to be cut back if another British carrier were licensed on the Naples route. Almost all the air traffic between England and Naples was being carried by BEA. Under the terms of the bilateral agreement, capacity offered by the two countries' operators was considered on a country-to-country basis and the Italians had complained of imbalance of capacity on this basis.

Mr Gardiner, for BUA, suggested that IT traffic had been created by the independent airlines and asked whether the independents were diverting traffic from BEA or the other way round. He referred to the use by Mr Marking of the phrase "BEA permitted share of traffic" in speaking of the Anglo-Italian bilateral agreement, and asked what agreement, or what clause of the bilateral agreement, limited BEA's share of the traffic. Mr Collingwood said that this was limited by confidential agreements between the two governments.

The next application, from BUA, was A.1006, for a four-times-weekly service from Gatwick to Rome. Mr McDonnell introduced the usual BUA document for this route and it was confirmed by Mr Whybrow. Mr Marking, cross-examining, asked whether Mr Whybrow did not think that 18 airlines provided enough competition; Mr Whybrow said that not enough of them were British. Mr Marking asked whether Mr Whybrow knew that BOAC had a large unused capacity over this route and whether he did not think that BUA would be likely to cause a reduction in the capacity BEA and BOAC were permitted to offer. Mr Whybrow repeated the suggestion that the independents, the corporations and the Ministry should jointly tackle the Italian Government.

Mr Collingwood, for BEA's objection, said that BOAC were already subject to a degree of restriction by the Italians and were operating some of their services through Rome without traffic rights. Traffic rights granted to any other British operator would certainly mean a cut in BEA's capacity. BEA load factors in recent years had never exceeded 80 per cent and the majority had been under 70 per cent; an adequate capacity was therefore already being offered. Mr McDonnell cross-examined and asked whether there was any change in BEA's arguments on the bilateral agreement in this case; there was not.

The next application, A.1025, by BUA, brought a change of country, though little change in the basic arguments. The route was from Gatwick to Athens, with a technical stop at Rome, the frequency weekly, from March to October.

Mr Whybrow, confirming the contents of BUA's supporting document, added the opinion that tourism to Greece was likely to increase considerably; many approaches had been made by agents who wanted special IT flights to Greece, but BUA thought that the agents would prefer to be able to book on scheduled flights at ITX fares. Mr Marking asked what Mr Whybrow knew about the Greek bilateral agreement and witness said that he understood it to be very restrictive. He suggested no particular reasons why BUA should be approved for this route.

The Anglo-Greek Bilateral

Mr Collingwood said that the Anglo-Greek bilateral was one of only three which specifically predetermined capacity, load factors and division of traffic. Paragraph 5 of the annexe to the agreement provided for equal capacity, agreed capacity, the discussion of capacity to be offered and the regulation of load factors. It was not, however, a case of 50-50 and no argument; in fact BEA were carrying 61 per cent of the traffic and the Greeks 39 per cent. The implications of the bilateral agreement had been modified by private agreements, but the introduction of BUA would have the same unfortunate results as elsewhere.

Mr Gardiner's cross-examination began with questions about BEA's figures and forecasts for the route. He then turned to the question of the bilateral agreement and suggested that it contained the usual reference to "airline or airlines" and could, in any case, be modified or cancelled. Mr Collingwood referred to his earlier evidence on the subject of this particular agreement; he did not think that better terms would be obtained by renegotiating it.

In order to release the Tradair representative from further attendance at the hearing, the Board then heard applications A.1272, 1275 and 1278, for services to Barcelona, Palma and Malaga; BEA had withdrawn their objection to the Barcelona application, but maintained their objection in respect of the services to Palma and Malaga.

Mr Porter confirmed that these applications were for the same class of service as the other applications from his company. He said that the liberal attitude of the Spanish Government to inclusive tour traffic was well known. Mr Porter then made a very brief final speech for the Tradair applications. He submitted to the Board that the Tradair applications were a creative idea and a logical attempt to set their inclusive tour operations on a firmer basis. British civil aviation would gain from the regularization of the inclusive tour traffic by its carriage on scheduled services rather than on chartered aircraft.

After 15 years' service with Cathay Pacific Airways throughout the Far East, DC-3 VR-HDA has now been sold to Air Laos. It was the only one of its type owned by Cathay Pacific, who also have a DC-4, a DC-6, a DC-6B and two Electras

AIR COMMERCE . . .

Next application was A.1019, by BUA, for a service from Gatwick to Nicosia. Mr Whybrow, for BUA, said that past traffic figures were unreliable as they had been affected by movements of British troops. Recent increases in BEA's traffic and enquiries from agents for IT flights to Nicosia indicated a big future for the route.

Mr Gardiner, for BUA, suggested that by 1965-66 total air traffic for the ten months over which BUA would operate would—according to BEA's figures—be approximately 22,000, of which number BUA expected to carry about 3,000. Mr Gilbert of BEA agreed.

Mr Marking called Mr Collingwood, who said that although there was not as yet any bilateral agreement between the UK and Cyprus, it was probable that one would soon be negotiated. Its form would be likely to resemble that of existing bilateral agreements and it would inevitably provide for capacity regulation in some way. The operations of Cyprus Airways as the designated Cyprus carrier on their route to Athens were at present carried out by BEA. Traffic between London and Nicosia was still, rather unexpectedly, going down, the first three months of 1961-62 being 18 per cent below the corresponding months in the previous year. Asked about existing and future competition on the route, Mr Collingwood of BEA agreed that there was none at present but thought it would materialize. He did not comment on Mr Gardiner's suggestion that competition between BEA and Cyprus Airways would, in fact, only be competition between BEA and BEA.

Skyways' Objection

Mrs Whittaker then spoke to the objection by Skyways. She said that Skyways had operated a service to Cyprus from October 1953 until the spring of 1960. At that time Cyprus was a Crown Colony and the route was not subject to IATA control so that very low fares could be charged. When the licence expired in 1960 it was not renewed by the British Government in view of the changed status of the island. Skyways had asked the Ministry what would be likely to happen if the Cyprus Government agreed to re-opening of the service and were told that if this happened they would be favoured.

British United Airways next presented their application A.1028 for a service Gatwick-Barcelona: this was opposed by BEA, BOAC and EAFS.

Mr McDonnell called Mr Whybrow as witness and went through the usual BUA supporting document with him. He emphasized that 625,000 UK residents had visited Spain in 1960, while there had been only 15,300 Spanish visitors to the UK. In the same year BUA had carried 8,951 passengers to Barcelona and Perpignan on IT flights; BUA's proposed weekly scheduled service would operate from May to September only and would provide a round trip capacity of 5,504, which, at 60 per cent load factor, would represent only 3,302 passengers a year. Mr Marking cross-examined Mr Whybrow, who agreed that BUA had applied for further IT flights; these, however, did not provide the security that BUA wanted because the agent could cancel the arrangement if bookings were below expectations. BUA wanted to develop their IT traffic on scheduled services and, if granted a licence for the route, would withdraw their IT special flights to Barcelona.

Mr Collingwood, giving evidence for BEA's objection, said that the Anglo-Spanish agreement was of the Bermuda type and did not specifically state that the traffic must be divided 50-50: the difference in this instance lay in the fact that BEA were carrying much more than 50 per cent of the traffic. Mr Marking asked his witness how BEA had escaped the 50-50 provision of the agreement (Mr Gardiner challenged the assumption that there was such an arrangement imp icit in the agreement) and Mr Collingwood said that this had been achieved through an agreement between BEA and Iberia: the Spanish airline was developing, however, and the position might change. Mr Collingwood agreed that there was no specific limitation of the share of the traffic: there was an agreement with Iberia which permitted a traffic ratio of 7 : 1 but this could not be produced.

The next application dealt with was BUA's A.1030, for a service between Gatwick and Palma. Mr Gardiner presented this application for BUA, mentioning that 116,000 IT passengers had been carried on the route by independents in 1960. Of this number BUA had carried more than 13,000; they were now asking for a licence to carry only 9,000 on scheduled services. The introduction of ITX fares on the scheduled services of BEA, he said, had taken away from the independents much of the IT business which they had generated, so that there was little security in the future of IT charter business. BUA had been granted a British licence to operate a service to Las Palmas and the Spanish, according to BEA, should have made a awful fuss about this but they didn't. They liked to call things "irregular services" and give licences on a monthly basis: this sort of thing might not appeal to BEA but it was working out very nicely for BUA, who were operating the service on the basis of monthly re-application.

Cross-examined by Mr Marking, Mr Whybrow agreed that it had taken since 1955 for Airwork and, subsequently, BUA to find a formula for satisfactory operation of the service to Las Palmas, eventually adopting the system of "irregular" operation on the basis of a temporary permit. Mr Marking also asked for more specific explanation of BUA's plans to surrender IT licences if granted licences to operate scheduled services.

Giving evidence for BEA's objection, Mr Collingwood repeated what he had said about the bilateral agreement between Britain and Spain in connection with the Barcelona application. On the London-Palma route, he said, the approximate figures for the year 1960-61 had been BEA 57,000, Iberia 10,000; he thought it unlikely that the Spanish Government would allow the imbalance to increase further.

Mr Gardiner's cross-examination turned once again to a lengthy examination of the implications of the bilateral agreement. Mr Gardiner stressed the use of the word "airlines" (in the plural) in the agreement and the provision made for the right of substitution of another carrier or the designation of an additional carrier or carriers. He suggested that capacity should be related to the traffic originating in the territory of the designating government. Finally Mr Gardiner asked whether Mr Collingwood was suggesting that there was anything in the bilateral agreement which gave the Spaniards the right to say that BEA must reduce their capacity if BUA put on a service. When Mr Collingwood said that the agreement had been interpreted in that way Mr Gardiner asked whether he thought that an Englishman could put that interpretation on it and suggested that, if so, some other Englishman had better talk with the Spanish Government.

The Malaga Applications

Next the Board heard an unopposed application from BEA, A.1111, for a service London-Malaga. They were told that this would be operated with Viscount, Vanguard, Comet or Trident aircraft.

Also unopposed, except by BOAC, was BUA's application A.1198, likewise for a service to Malaga. Presenting the application, Mr Gardiner said that, like BEA, they believed a demand for the service existed.

Mr Gardiner said, speaking generally, that BUA would like some indication of the possible attitude of BEA should licences be granted to the independents. Asked to amplify this statement, he said that it was possible that BEA, in defence of their commercial interests, might make some arrangement with foreign operators or foreign governments with whom they had agreements, for the surrender of certain privileges provided the independents were excluded. He did not say that this would happen, but it was a possibility that had to be considered.

The next application to be heard, number A.1135, was from Overseas Aviation, for a service from Birmingham to Geneva; Mr Pink, putting the case for Overseas Aviation's application, said that the service would provide the first direct link between Birmingham and Geneva.

Mr Marking began his cross-examination for BEA by asking whether Overseas Aviation had supplied details of their financial state to the Board and whether Mr Pink had any information to offer about his company's indebtedness to BEA. Mr Pink read a letter from the company accountant, referring to BEA's claim that a sum of more than £1,000 was owing to them; the letter stated that a credit note from BEA for an approximately equal sum was awaited by an associate company of Overseas Aviation and the payment to BEA was being held up until this matter had been settled. Mr Marking commented that, "all being well," Overseas Aviation would shortly be getting a writ, and asked again whether a statement of Overseas Aviation's assets and liabilities had been supplied to the Board; he suggested that these details be supplied in respect of all the associated companies.

The Chairman then said that the Board had already made certain requests to Overseas Aviation and Mr Marking said that he would, in that case, not pursue the matter further.

Mr Pink next referred to Overseas' application A.1140, for a service from Birmingham to Salzburg and Rimini. He repeated the general remarks he had made in presenting the application for Geneva.

Mr Ashton Hill spoke for Cunard Eagle's objection to this application. He said that CEA were already authorized to operate between Manchester and London and Rimini.

Application A.1064, by Cunard Eagle for a service between Manchester-Birmingham and Nice, came next.

Eagle Airways had applied for a licence in 1954 and had been informed that one would be granted provided the French agreed. As the French had made it a condition that BEA should surrender capacity equal to that to be offered by CEA the licence had eventually been refused.

Mr Marking cross-examined and said that he had been most interested in Mr Ashton Hill's history of the route in view of previous arguments over the attitude of the French on the subject of traffic rights. Would Mr Ashton Hill agree that it was difficult to get traffic rights out of them? Mr Ashton Hill did agree with this.

[To be concluded next week]

GROUNDS OF THE BOAC APPEAL

FIRST public indication of the grounds of BOAC's appeal against the ATLB's licensing of Cunard Eagle on the North Atlantic route is a notice to corporation staff in *BOAC News*. The hearing will start on Tuesday September 26, in public at the Holborn Town Hall. As already reported, Sir Fred Pritchard, a retired High Court Judge, will hear the appeal. BOAC are, they say, "entitled to introduce fresh evidence, and in this connection will wish to produce figures relating to the current season's North Atlantic traffic which has fallen far short of expectation. As a result, it would seem that the forecasts on which the Licensing Board's decision is based are likely to prove over-optimistic.

"A second ground of appeal is that the ATLB's decision, in a number of respects, is inconsistent with the evidence given at the hearing and indeed, in some cases, inconsistent with the ATLB's own findings of fact. A further ground of appeal is that the Licensing Board's decision will not further the development of British civil aviation as is required by the Act. A final ground of appeal is that the Licensing Board has misconceived its functions under the Act."

Having heard the appeal, the Commissioner will make a recommendation to the Minister (which he is bound to publish) as to the decision the Minister should make on the appeal. The Minister can, of course, reject the recommendation in whole or in part but if he does he must make public his reasons for so doing. The appeal will certainly test to the utmost the "fathers in God" relationship, as it has been described, of the Ministry to the corporations.

CONTINENTAL 707 HI-JACKED

THE spectacle of a big jet airliner moving down the runway pursued by police in cars firing sub-machine gun bullets into the tyres seems more like Hollywood than real life. But it became reality at El Paso, Texas, on August 3 (see picture on page 236), when Leon Bearden and his 16-year-old son seized a Continental Airlines Boeing 707-124 at gunpoint in an attempt to force the crew to fly to Havana. The 707 was on its way from San Francisco to Houston via El Paso, and was seized just before landing at El Paso. Four of the passengers and six crew were held as hostages, the remaining 63 passengers being released. For five hours attempts were made to persuade the pirates to surrender; the ground staff delayed take-off as long as possible by taking about four hours to top up the tanks and check the hydraulic system.

The 707 started to move down the runway with police cars in pursuit firing into the tyres and also (it is reported) into one of the engines. In the best Hollywood tradition, it all ended with a smart uppercut: Glenn Gilman, a border patrol man, who had slipped on board the 707 (according to one report, while one of the pirates was "making rude gestures" out of a window) punched Leon Bearden on the chin while two G-men, following close behind, helped disarm Bearden's son. While the 707 was still under their control Continental flew a DC-7B into El Paso and offered it to the pirates to fly to Havana; President Kennedy, who was kept informed of events by telephone, vetoed this. The FAA has now authorized all American aircrews to carry arms if they are proficient in their use. The US Government is offering a reward of $10,000 for information leading to the arrest of persons attempting hi-jacking.

It later transpired that the Beardens seized the Continental 707 not out of any pro-Castro sympathies, but with the apparent intention of selling it to the Cuban Government. Whether they would have got any money for it is a matter for conjecture, since the two Boeing 707-139s ordered by Cubana several years ago were never delivered, because it is believed Cubana could not find the money for them; several Cubana Britannia deliveries were delayed due to payments difficulties. The two Cubana 707s have been leased by Boeing to Western for more than a year now.

Footnote A Pan American DC-8 with 72 passengers and a crew of nine on board was hi-jacked on August 9 after taking off from Mexico City for Guatemala, San Jose (Costa Rica) and Panama. The hi-jacker, who was not a Cuban, made the pilot fly to Havana, where the DC-8 later took off for the States. Its early release was due largely to the fact that the Colombian Foreign Minister was on board. The Eastern Electra hi-jacked on July 24 is still in Cuba.

TWA SUES HUGHES

HOWARD HUGHES has been a name for so long associated with TWA that it came as a great surprise when TWA last week filed a claim for damages amounting to $105m (£37.5m) against Hughes in the Federal Court in New York. The airline alleges that Hughes has used his controlling (78 per cent) interest in TWA to monopolize the sale of jet aircraft to the airline. Both aircraft sales and the controlling interest operated through the Hughes Tool Co, which manufactures oil well drilling equipment and is a very prosperous concern; it is the foundation of the Hughes personal fortune which is estimated at over $500m (£178.5m). It was generally believed that the Hughes Tool Co had purchased Boeing 707s and Convair 880s for TWA because of the latter's poor financial standing, but TWA's case is that the Hughes Tool Co's intervention between manufacturer and airline prevented TWA from making more advantageous purchase agreements with the manufacturers themselves, besides monopolizing the supply of jet aircraft to TWA. The Hughes Tool Co, it is claimed, injured the airline in its business and property to the extent of more than $35m (£12.5m); triple damages are being sought.

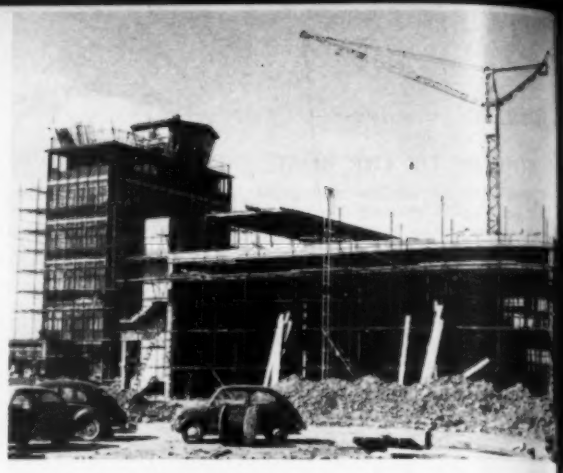
TWA was late in acquiring 707s and because of financing difficulties was unable to take immediate delivery of its Convair 880s. When the financing of TWA's jets became too much for Hughes, surrender of his personal control over the airline was the price demanded by the consortium of financial interests which took over the burden. A voting trust with three trustees was set up earlier this year as a condition to loans totalling $165m (nearly £59m) from this consortium, but one of the three trustees, Raymond M. Holliday, is named in the suit by TWA as is the Hughes Tool Co; the Atlas Corporation, in which Hughes has an 11 per cent interest held in trusteeship, is named as a "co-conspirator" but not as a defendant. The Atlas Corporation controls Northeast Airlines, which had been discussing a merger with TWA before Hughes relinquished control of the latter. Conspiracy is alleged to complete the merger on terms disadvantageous to TWA and to help the Hughes Tool Co dispose of the aircraft it had agreed to buy. TWA's original order for 30 Convair 880s was cut back to 20, and of the remainder Northeast operates six lease-purchased from Convair and four are being delivered to the order of the Hughes Tool Co. TWA's anti-trust suit asks that Hughes Tool be forced to sell all its holdings in TWA.

FRIENDSHIP CENTURY

A REPEAT order for two Friendships placed by Philippine Air Lines brings the number of these aircraft sold by Fokker to 100, a total which it has taken five years, one month and four days to achieve. The first sale, to Aer Lingus, was made on June 27, 1956. Two months before Fairchild had acquired a licence to build the Friendship; a total of 86 have been built at Hagerstown, and Fairchild has begun production of a small further batch. A total of 64 customers have bought Friendships from Fokker and Fairchild, and Fokker have delivered 73 of the 100 on order. These include VIP versions for HM Queen Juliana of the Netherlands, HIM the Shah of Persia and HE the President of the Phillipines, a well as airline versions for 20 operators. The Royal Netherlands Air Force is taking delivery of nine Troopships, the military version, and three Freightships fitted for cargo carrying.

Average flight time over all stages operated by Fokker-built Friendships is only 54 minutes; corresponding figure for Fairchild-built F-27s is less than 30 minutes. In spite of the short-haul nature of most Friendship operations, utilizations in excess of 10 hours per day have been achieved, and by the end of July the 157 Friendships in service all over the world had accumulated a total flying time of more than 400,000 hours. The PAL order which brought the total up to 100 was the twelfth repeat order and the 35th individual contract placed with Fokker. PAL's Friendships have achieved utilizations of about 11 hours each a day during the peak season.

BEA'S chief executive, Mr Anthony Milward (left) has signed a £2.5m contract with Standard Telephones and Cables Ltd for the first part of the corporation's new electronic reservations system, which will be in operation late in 1963. He is seen here with Mr K. A. Frost of STC examining a key set. The second stage of the system will be in full operation by the end of 1964 at an estimated final cost of £4½m



The 85ft seven-storey control tower and terminal building at the new Cork airport seen from the approach-road side. The 150-acre airport stands on a plateau 450ft above sea-level and will be opened for traffic on October 16. The architect is Mr L. M. Carroll, chief airport architect, Irish Department of Transport and Power

AIR COMMERCE . . .

THE STAVANGER TRAGEDY—

A PARTY of 34 schoolboys and two masters from the Lanfranc Secondary Boys' School, Croydon, and also the captain, first officer and stewardess, were lost when Cunard Eagle Viking G-AHPM crashed into the 1,730ft-high Holtahei, a mountain 21 miles north-east of Stavanger, on August 9. The Viking was on a charter flight to Stavanger and had been chartered by AIR Tours, of Great Harwood, near Blackburn. It had been due to leave London at 9.30 a.m. but its departure was delayed for five hours due to an ignition fault. It was due at Sola airport, Stavanger, at 4.59 p.m. and the pilot, Capt P. Watts, reported that he was coming in on ILS in bad weather with heavy wind, rain and poor visibility.

Wreckage of the Viking was not found for about fifteen hours, on a 1,700ft peak some 15 miles east of the ILS track. The aircraft was valued at about £17,500 for insurance purposes and the whole of this loss will be borne by the London market.

By the time the Viking reached Stavanger there was a 70 m.p.h. westerly gale with low cloud and driving rain, and it seems that Capt Watts was blown off course towards the mountains. It is not yet clear why he was not being radar vectored, nor why he did not ask for a GCA; although the Sola GCA shuts down at 4 p.m. it is available afterwards at an hour's notice. Capt Watts started an ILS procedure turn and his last message was "over outer marker outward bound at 2,000ft." He was then cleared by Sola to descend to 1,400ft but nothing more was heard.

—CALLS FOR A PUBLIC ENQUIRY

THE last fatal accident involving passengers to a British airliner occurred almost exactly two years ago, on August 19, 1959, when Transair DC-3 G-AMZD hit a mountain near Barcelona, killing all on board, 29 passengers (young students) and the crew of three. Like the tragedy recorded above, the aircraft was on a charter flight, operating an inclusive tour. A number of very important questions were either unsatisfactorily answered, or were never answered at all, by the Ministry (*Flight*, May 27, 1960).

The brief official report was, under international law, the work of the Spanish Government. It was in effect a vindication of the Spanish air traffic control authorities, and it was published without any comment by our Ministry. We described the report—500 words in 1½ pages—as "one of the briefest to reach this office," and MPs described it as "shockingly inadequate."

The questions that were asked about that accident, and which will be asked about the Stavanger tragedy, were: (1) How adequate are the regulations regarding the route-checking of pilots operating charter flights? The reply in the case of the Barcelona accident (given by Mr Geoffrey Rippon, PPS to the Ministry of Aviation) was that the pilot and the crew were properly qualified and experienced. In the case of a non-scheduled journey the law required, said Mr Rippon, that the pilot should, within 12 months, have been tested as to his knowledge of the terrain and other operational aspects of the route. It was also required that within six months he should have been tested as to his proficiency in using the relevant instrument approach system. Mr Rippon was asked why it was, then, that the first time the pilot concerned flew on the route was as captain of the aircraft. The reply was that while pilots are required to be under supervision on a scheduled service if they have had no previous experience of a route, this did not apply in the case of charter flights. The difference was that charter flights "can be postponed more easily if a pilot for any reason feels unhappy." (2) How did the Ministry satisfy themselves that the pilot had passed the test required by the regulations as to his knowledge of the route? This question was not answered. (3) Was the flight plan inspected, and what evidence was given at the inquiry? These questions also were not answered.

Naturally, since the Stavanger tragedy is *sub judice*, Cunard Eagle are unable to answer the essential question: Was the captain properly route-checked according to the regulations? It must be supposed that the answer, in the case of a company of Cunard Eagle's repute, is that the captain was indeed properly checked *according to the regulations* (and, in fact, *Flight* understands that he was). Nevertheless, two questions arise: (1) How adequate are the regulations covering the route-checking of charter-flight pilots? (2) How does the Ministry satisfy itself as to the proper checking of the pilots of the hundreds of other passenger charter flights—many of them carried out by independents with less resources than those of Cunard Eagle (and often employing part-time free-lance pilots)?

These questions call for a full public enquiry into the disaster.

POOLING AND PUBLIC ACCOUNTABILITY

IN our correspondence columns on page 235, Mr Henry Marking of BEA contributes to the important subject of the extent to which the corporation is accountable to the Minister for its pooling agreements.

It has always been the view of *Flight* that BEA and BOAC should be accountable to the Minister for their pooling agreements. Briefly, our reasons are as follows: (1) Pooling is a restrictive commercial practice, unchecked by the Trade Restrictive Practices Act, which does not apply to services (only to goods); (2) there is *prima facie* evidence that, through pooling agreements, BEA and BOAC are "carrying" other airlines, including UK independents; and (3) pool agreements, by enabling BEA and BOAC to buy off foreign restrictionism in traffic rights, relieve the Minister of what is primarily *his* job of getting better bargains for British air transport as a whole.

It has therefore always seemed reasonable that our airlines should be accountable to the Minister for their pooling agreements. This is why, a year ago, we asked the Ministry (*Flight*, September 9, 1960) whether they required our airlines to file their pool agreements with the Ministry. The answer was: "*No, we do not require the airlines to file with us the terms of pool agreements. They are a matter for the commercial judgment of the airlines.*"

The present controversy arose because Mr Marking of BEA, telling the Air Transport Licensing Board that there was no mystery about pooling agreements, said that "*the contents of the agreements are well known to the Ministry of Aviation, who have been in possession of such agreements since they were concluded*" (*Flight*, August 3).

Because this did not tally with what the Ministry had said a year before, we asked the Ministry to comment. Their reply (*Flight*, August 3) was: "*The facts are that neither by requirement nor as a matter of courtesy are all these agreements lodged with the Ministry*" —though BEA had kept the Ministry informed of the "essential contents" of pool agreements.

This reply still did not tally with what BEA had told the Board. Asked to comment, BEA said (August 3 issue): "*Senior people in the Ministry have, on a personal and private basis, seen all BEA's pool agreements.*"

This is the background to the letter from BEA on page 235 of this issue. Still puzzled by what appears to be equivocation on a point of some importance, we asked the Ministry to comment on the BEA letter before it went to press. Their reply was that they could add nothing to their previous comment.

OVERSEAS AVIATION IN TROUBLE

IN a move that could mean the end of Overseas Aviation, British Petroleum last Friday decided to stop supplying the company with fuel from midnight on August 13. Overseas expressed its "extreme astonishment," saying that an agreement to pay £2,000 a day for fuel had been faithfully adhered to for a number of weeks.

Living on credit for petrol is a common practice and many independents rely on it during the summer, settling the bill when the revenues are in at the end of the season. But the amount owed by Overseas to BP is now about £250,000. The £2,000 per day being paid by Overseas is in respect of current supplies only. BP's action is obviously an extreme measure, and can have come as no surprise to Overseas.

Although Overseas has recently purchased 15 North Stars from TCA, the company's financial resources have been the subject of recent exchanges before the Air Transport Licensing Board, in one of which BEA stated that Overseas would be issued with a writ in respect of debts.

Stop press: A petition for the winding-up of Overseas Aviation (CI) Ltd is being jointly presented by BP and Rolls-Royce. BP say that because an examination of Overseas' trading position indicates continuing losses, it has been decided that "the matter should be brought to a head."

STILL GOOD FRIENDS

THE on-off-on engagement between BOAC and MEA, first announced in 1955, has now been finally broken off. A joint announcement by the two chairmen, Sir Matthew Slattery and Sheikh Najib Alamuddin, on August 10 said in effect that BOAC have agreed to the Sheikh's suggestion for the sale of BOAC's 48.5 per cent shareholding in MEA. Both felt that the future of MEA would be "best assured" by this arrangement; MEA would become "a completely independent Lebanese airline."

BOAC declined last week to comment on the terms of the deal, which ends a relationship that has often been rather strained. BOAC has invested more money in MEA than in any other associate. This investment appears in the BOAC 1960-61 annual report as £3.6m less provision for losses. Official figures of the amounts advanced by BOAC to MEA have never been published. In evidence before a Parliamentary select committee in 1959, Sir George Cribbett, then chairman of BOAC AC, said that the investment to that date was of the order of £6m. This figure was presumably made up of advances for equipment and general funding purposes, and it may or may not have included BOAC's investment in MASCO (Mideast Aircraft Service Co), the Beirut engineering concern disbanded in August 1960 after heavy capital expenditure by BOAC, and taken over by MEA.

Twice in the past the BOAC/MEA association has been close to rupture. In September 1959 the Sheikh took strong exception to the now notorious suggestions in Parliament that MEA was "one big sieve through which public money has been poured," and to subsequent adverse comments by the then Minister, Mr Harold Watkinson. The Sheikh said MEA would buy out the BOAC shareholding (about £400,000), and would raise money in the Lebanon to repay the BOAC funding loans by 1962 and the BOAC equipment loans by 1968. The disagreement was patched up in the next month, October 1959, when BOAC offered to lend MEA an additional £1.13m as capital, and to help MEA purchase Comets. Agreement on the latter point was not finally reached until March 1960 when the Sheikh threatened to "go elsewhere" for new jets, either Caravelles or Convairs, unless Treasury approval for the Comet deal was forthcoming. Treasury approval was almost immediately forthcoming; MEA placed an order for four Comet 4Cs, and BOAC guaranteed the financing arrangements in what was described by the Chancellor of the Exchequer at the time as "a highly complicated and intricate case," details of which have never been disclosed.

The break has come now because MEA needs more capital to further its plans for pan-Arab air transport. The Sheikh has long sponsored the idea of greater Arab air transport unity, an idea which has held the promise of further Comet orders in the Middle East—from Iraqi Airways, for example, and from Kuwait Airways. But a political and ideological *entente* with UAA (who have their own ideas about pan-Arab air transport leadership) appears to be elusive.

At any rate, the Sheikh evidently feels that BOAC is not willing to invest in pan-Arab air transport; and he also is known to deplore the delays that arise through having to deal with two BOAC boards (BOAC and BOAC AC) and two Government bodies (the Ministry and the Treasury). Furthermore, he is outspoken about alleged BEA poaching in the Middle East (a subject on which he and BOAC probably see eye to eye).

There is no truth, say MEA, in reports last week in the *Daily Express*, that the Sheikh is now seeking to join forces with one of Britain's two biggest independents, British United or Cunard Eagle. Nor is he likely to do a deal with a foreign BOAC competitor; MEA wants to be independent.

It would probably be fair to sum up the situation by saying that MEA have had a very generous financial deal from BOAC and the British Government over the past six years. On the other side of the coin BOAC has maintained valuable traffic and feeder rights, and political influence, in the Middle East; and the British aircraft industry has received orders for Viscounts and Comets from MEA amounting, with spares and so on, to perhaps £9m. It is for such reasons as these that the Government (which is said to have been politically against the breaking of the BOAC/MEA engagement) must hope that the two airlines will remain good friends. MEA insist that they hope so too.

J. M. R.

BREVITIES

Mr C. G. Carroll has been appointed general commercial manager of BUA. He has hitherto held the post of personal assistant to Mr F. A. Laker, executive director.

Lufthansa took delivery of its tenth Viscount 814 at Hamburg on July 31; a further Viscount is to be delivered shortly, bringing the total owned by Lufthansa to 11.

A repeat order for three Boeing 720B medium jets has been placed by Northwest; two will be leased from Boeing and the third purchased. Northwest now has nine 720Bs on order, of which four are in service.

Lord Brabazon has accepted an invitation by Mr Peter Thorneycroft, Minister of Aviation, to become chairman of the Air Safety Board in succession to Air Marshal Sir Charles Guest, KBE, CB.

The President of Brazil, in a move to strengthen international air transport operations, has approved the joint participation of REAL and Varig in Aerovias Brasileiras, and the reorganization of Panair do Brasil.

Delta, following their recent order for three Douglas DC-8 Series 50s for delivery in May, June and July 1962 (the airline already has six DC-8 Series 10s), have ordered four more Convair 880s to bring their fleet of these aircraft up to 16.

According to *Interavia*, the British Aircraft Corporation is reported to have offered £16m credit to enable UAA to purchase new long-haul jets. As already reported, UAA is considering the purchase of either Boeing 707, 720 or Vickers VC10 jets.

Replying to PanAm's complaint to the CAB regarding KLM violations of the US/Netherlands bilateral air agreement, KLM opposes possible institution of proceedings by the CAB on the grounds that the CAB has no power to take such unilateral action, and that procedures are explicitly laid down in the air agreement for discussion in case of a difference of opinion between the parties.

The Prime Minister of Ceylon, Mrs S. Bandaranaike, has appointed a three-man committee to investigate Air Ceylon's affairs and to make recommendations on the airline's future. The committee comprises Mr M. Senanayake, Minister of Industries; Mr P. B. G. Kalugalle, Minister of Transport; and Mr F. D. Bandaranaike, Minister of Finance.

Mr A. M. Blakemore, secretary of BIATA, is to join British United Airways in October.

Austrian Airlines is reported to have negotiated a loan worth $3,120,000 (over £1.1m) from the Morgan Guaranty Trust Company in the USA to pay for its six Viscount 837s.

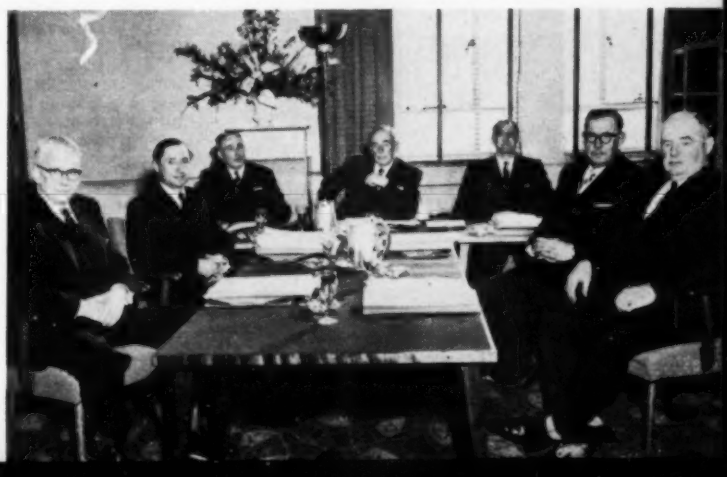
According to a report in the *Financial Times*, negotiations are going on between Fokker and East African Airways for the sale of three Friendships.

Mr L. F. E. Coombes, technical secretary of BALPA, is to join the technical sales department of Smiths Aircraft Instruments Ltd in September.

A Dakota of the Hungarian airline Malev on a summer sightseeing flight crashed in a residential district of Budapest on August 6, with the loss of all four crew and 20 passengers on board.

Sydney's Kingsford Smith airport will have its main runway extended for use by big jets, making a second runway suitable for these aircraft. The present jet runway is from east to west. Extensions to one of the runways at Perth's airport are planned to bring it to jet standard before the Empire Games in November 1962.

The US State Department announced on August 7 that agreement had been reached on all basic questions in the US-USSR civil air agreement talks which are now being carried on between PanAm and Aeroflot. An agreement was expected to be signed as this issue went to press.



Now an all-New Zealand airline, following the purchase of Australia's shareholding, TEAL now has an all-New Zealand board. They are, left to right: A. F. Gilkison, A. R. Guthrey, F. A. Reeves (general manager), Sir Leonard Isitt (chairman), A. A. Watson (secretary), G. A. Nicholls and G. N. Roberts

A 20,000lb gravel crusher being unloaded from a Beverley of 84 Sqn at Beihan in the Western Aden Protectorate, where it is to be used by 5004 Airfield Construction Sqn in the laying of a 1,400yd tarmac runway. It had been flown in from RAF Khormaksar, Aden, to the Beihan airstrip, which is 4,000ft a.s.l.

SERVICE AVIATION

Air Force, Naval and Army Flying News

Sarum to Storey's Gate

IN October the post of Assistant Chief of Defence Staff at the Ministry of Defence is to be taken over by AVM D. R. Evans, CB, CBE, DFC; he succeeds an Army officer, Maj-Gen G. R. D. Fitzpatrick, DSO, MBE, MC, who has held the appointment since October 1959.

AVM Evans, who is 49, has been Commandant of the School of Land/Air Warfare at Old Sarum since May 1959; prior to that he was SASO at Fighter Command. In pre-war years he flew with 45 Sqn in the Middle East, then took a specialist signals course and joined the signals staff at Fighter Command headquarters at the outbreak of war. In 1941 he commanded an interception unit carrying out night fighter trials at Ford, Sussex, being awarded the DFC for destroying two enemy aircraft; then he went to 11 Group as group captain i/c night operations. The following year (1943) AVM Evans was posted to Mediterranean Air Command headquarters, where he was concerned with signals planning for the Sicily invasion; later he joined the Allied Expeditionary Air Forces for similar duties in connection with the Normandy landings. After the war he graduated at the Staff College, commanded the Telecommunications Flying Unit at Defford and later became group captain i/c plans at Fighter Command.

Commanding the Carriers

A NEW appointment has been announced for Rear Admiral F. H. E. Hopkins, CB, DSO, DSC, who has been Flag Officer Flying Training since September 1960: from next January he is to be Flag Officer Aircraft Carriers in succession to Rear Admiral R. M. Smeeton, CB, MBE.

Rear Admiral Hopkins, who joined the Navy as a 17-year-old cadet, has been active in the Fleet Air Arm since he qualified as an observer at Lee-on-Solent in 1934. He won the DSC in 1940, the DSO in 1941 when commanding 830 Sqn in the Middle East; later he served with the American Fast Carrier Task Force in the Pacific, then cross-trained as a pilot, in 1945 completing the fighter course at the School of Naval Air Warfare. He flew in operations off Korea, receiving a Mention in Despatches. Among his recent appointments has been command of HMS *Ark Royal* (1956-58). In this year's Birthday Honours he was made a CB.

Jungle Ordeal

A JAVELIN navigator, M Nav A. D. Melton, was rescued from the Sundarbans jungle in East Pakistan last week after ejecting from his aircraft on a ferry flight from Waterbeach to Singapore: he had spent three days without food, drenched by monsoon rains. His pilot, Flt Lt E. Owens, lost his life either on ejection or when he landed in a tree.

M Nav Melton owed his life to the Sarah transmitter carried in his Mae West and to a 205 Sqn Shackleton which picked up the transmission and dropped food and a Very pistol. Firing this pistol guided a rescue party which had been landed by an amphibian. The only injury Melton incurred was a cut leg, although the mangrove swamps in which he came down—about a hundred miles south-west of Dacca, capital of East Pakistan—are known to be full of wild animals. Government and civilians co-operated in his rescue.

Flt Lt Owens and M Nav Melton, whose aircraft was in formation with another Javelin when the emergency occurred, were ferrying the machine to 60 Sqn at Tengah. This squadron, formerly equipped with Meteors, is being re-equipped to operate Javelin FAW.9s.

Crew of the RAAF Convair Metropolitan to be used by Australia's new Governor-General, Lord de L'Isle and Dudley, VC. Left to right, LAC W. J. Bankes, steward; Flt Lt J. T. Carter, captain; Fg Off I. D. Bridge, co-pilot; Flt Lt N. Reidy, navigator; Cpl R. W. Downie, fitter

Assaulting Farnborough

THERE is to be a new type of Royal Air Force participation in this year's SBAC Show at Farnborough: tactical transport operations by aircraft of 38 Group, supported by eight Hunter FGA.9s of 54 Sqn, which are to open the "assault" with a simulated attack on the control tower. Helicopters and STOL machines will be engaged in troop landings and supply sorties—Whirlwinds (and possibly Belvederes), Beverleys, Pioneers and Twin Pioneers.

Another distinctive feature of the half-hour RAF display will be the presence of three formation aerobatic teams—92 and 74 Sqns (Hunters and Lightnings respectively) and Jet Provosts of the Central Flying School. On the ground, teams from Bloodhound squadrons will demonstrate operational routine up to the point of firing; and at contrail height (provided the weather is suitable) 14 V-bombers are to fly over Farnborough during each day's display.

Admiral of the Fleet Earl Mountbatten of Burma meeting officers of India's first aircraft carrier, "Vikrant" during her recent visit to Portsmouth. At right is the captain, Capt P. S. Mashindroo

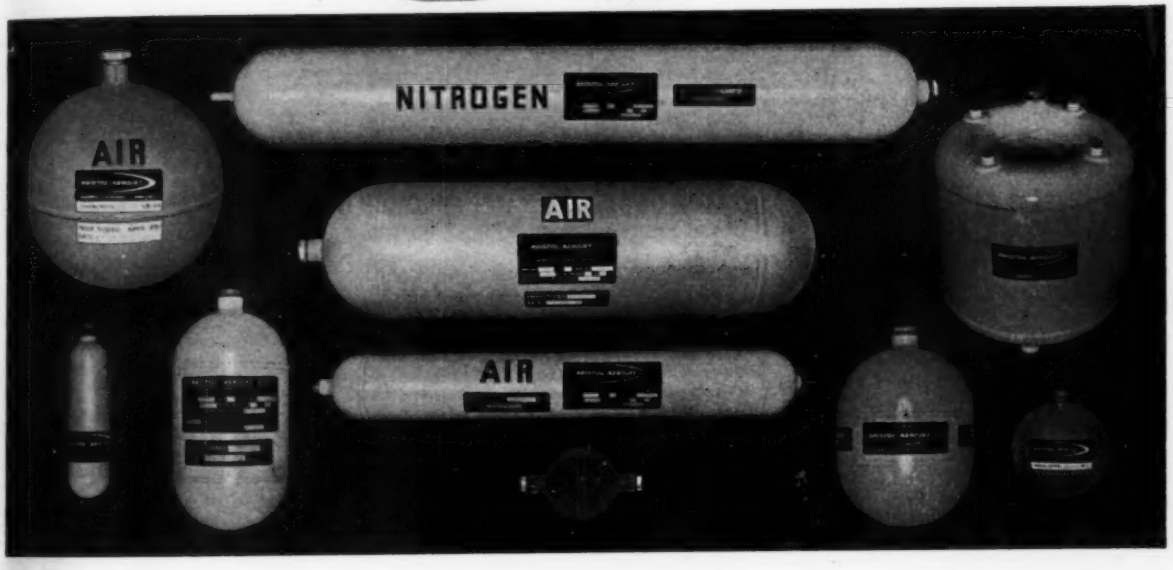
IN BRIEF

Fg Off John Volkers, who set up a record time of 42min 34sec in the London - Paris race two years ago, last week lost his life in a Hunter accident while flying with No 8 Sqn at Aden.

A reunion of former flying-boat personnel is to be held on September 23 at Pembroke Dock. Tickets £2. Those interested should contact Mr W. R. Foster at Tampines, Phyttle, Chalfont St Peter, Bucks.

Failure of the tail rotor shaft was given at a Portland inquest last week as the reason why a 771 Sqn P.531 went into the sea off Portland Bill a month ago. The pilot, Lt B. R. Allen, escaped when the helicopter was 30ft below the surface. His navigator, Lt C. C. McClure, was apparently unable to free himself. A verdict of death by misadventure was recorded.

PERFORMANCE PAYLOAD PROFITS UP



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Other transport aircraft currently on offer include a newly available batch of two B.E.A. type D.C.3s, Argonaut/North Star and DC.7C aircraft.

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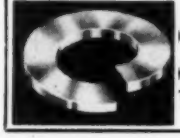

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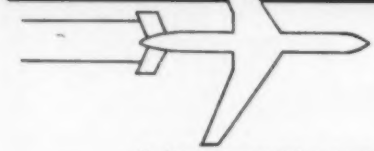

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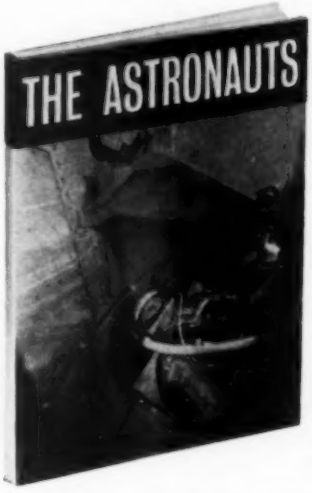

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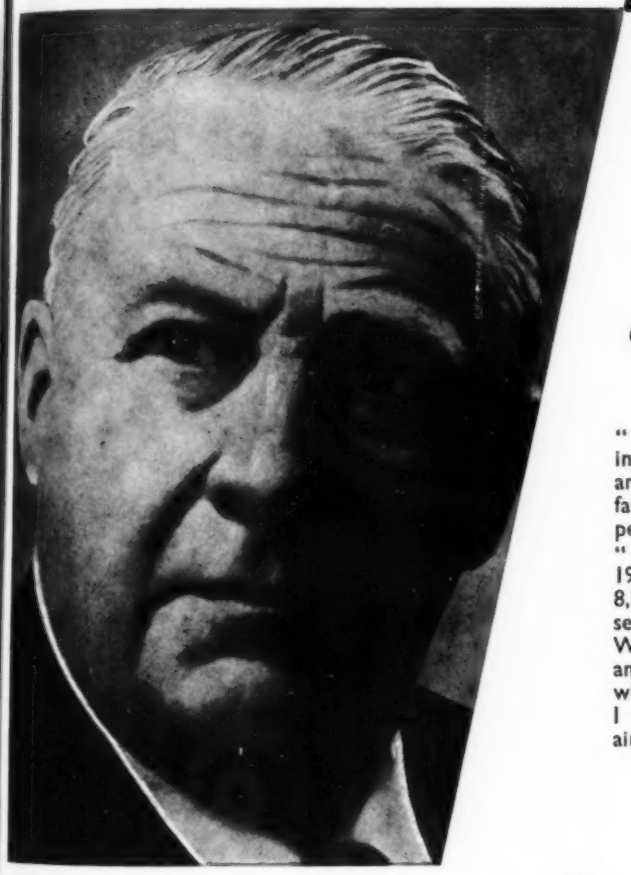

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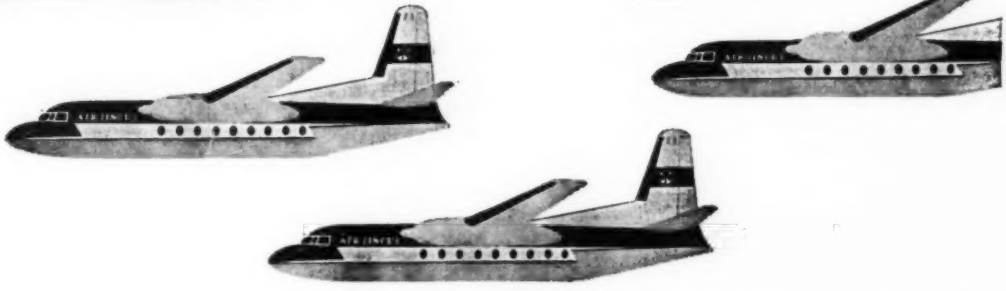

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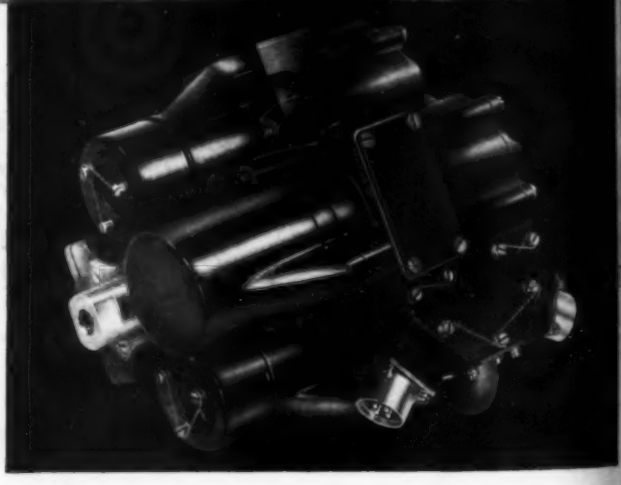

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